SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; CHARLES D. WALCOTT, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; WILLIAM H. WELCH, Pathology; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, DECEMBER 6, 1901.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*HENRY AUGUSTUS ROWLAND.**

IN reviewing the scientific work of Professor Rowland one is most impressed by its originality. In quantity, as measured by printed page or catalogue of titles, it has been exceeded by many of his contemporaries; in quality it is equaled by that of only a very, very small group. The entire collection of his important papers does not exceed thirty or forty in number and his unimportant papers were few. When, at the unprecedentedly early age of thirty-three years, he was elected to membership in the National Academy of Sciences, the list of his published contributions to science did not contain over a dozen titles, but any one of not less than a half dozen of these, including what may properly be called his very first original investigation, was of such quality as to fully entitle him to the distinction then conferred.

Fortunately for him, and for science as well, he lived during a period of almost unparalleled intellectual activity, and his work was done during the last quarter of that century to which we shall long turn with admiration and wonder. During these twenty-five years the number of industrious cultivators of his own favorite field increased enormously, due in large measure to the

* Address by Dr. T. C. Mendenhall at the Memorial Meeting at the Johns Hopkins University on October 16.

stimulating effect of his own enthusiasm, and while there was only here and there one possessed of the *divine afflatus* of true genius, there were many ready to labor most assiduously in fostering the growth, development and final fruition of germs which genius stopped only to plant. A proper estimate of the magnitude and extent of Rowland's work would require, therefore, a careful examination, analytical and historical, of the entire mass of contributions to physical science during the past twenty-five years, many of his own being fundamental in character and far-reaching in their influence upon the trend of thought, in theory and in practice. But it was quality, not quantity, that he himself most esteemed in any performance; it was quality that always commanded his admiration or excited him to keenest criticism; no one recognized more quickly than he a real gem, however minute or fragmentary it might be, and by quality rather than by quantity we prefer to judge his work to-day, as he would himself have chosen.

Rowland's first contribution to the literature of science took the form of a letter to *The Scientific American*, written in the early autumn of 1865, when he was not yet seventeen years old. Much to his surprise, this letter was printed, for he says of it, 'I wrote it as a kind of joke and did not expect them to publish it.' Neither its humor nor its sense, in which it was not lacking, seems to have been appreciated by the editor, for by the admission of certain typographical errors he practically destroyed both. The embryo physicist got nothing but a little quiet amusement out of this, but in a letter of that day he declares his intention of some time writing a sensible article for the journal that so unexpectedly printed what he meant to be otherwise. This resolution he seems not to have forgotten, for nearly six years later there appeared in its columns what was, as far as is known, his second printed paper and his first serious public discussion of a scientific question.

It was a keen criticism of an invention which necessarily involved the idea of perpetual motion, in direct conflict with the great law of the conservation of energy which Rowland had already grasped. It was, as might be expected, thoroughly well done and received not a little complimentary notice in other journals. This was in 1871, the year following that in which he was graduated as a civil engineer from the Rensselaer Polytechnic Institute, and the article was written while in the field at work on a preliminary railroad survey. A year later, having returned to the Institute as instructor in physics, he published in the *Journal of the Franklin Institute* an article entitled, 'Illustrations of Resonances and Actions of a Similar Nature,' in which he described and discussed various examples of resonance or 'sympathetic' vibration. This paper, in a way, marks his admission to the ranks of professional students of science and may be properly considered as his first formal contribution to scientific literature; his last was an exhaustive article on spectroscopy, a subject of which he, above all others, was master, prepared for a new edition of the Encyclopædia Britannica, not yet published.

Early in 1873 the *American Journal of Science* printed a brief note by Rowland on the spectrum of the Aurora, sent in response to a kindly and always appreciated letter from Professor George F. Barker, one of the editors of that journal. It is interesting as marking the beginning of his optical work. For a year, or perhaps for several years, previous to this time, however, he had been busily engaged on what proved to be, in its influence upon his future career, the most important work of his life. To climb the ladder of reputation and success by simple, easy steps might have contented Rowland, but it would have been quite out of har-

mony with his bold spirit, his extraordinary power of analysis and his quick recognition of the relation of things. By the aid of apparatus entirely of his own construction and by methods of his own devising, he had made an investigation, both theoretical and experimental, of the magnetic permeability and the maximum magnetization of iron, steel and nickel, a subject in which he had been interested in his boyhood.

On June 9, 1873, in a letter to his sister, he says: "I have just sent off the results of my experiments to the publisher and expect considerable from it; not, however, filthy lucre, but good, substantial reputation." What he did get from it, at first, was only disappointment and discouragement. It was more than once rejected because it was not understood and finally he ventured to send it to Clerk Maxwell, in England, by whose keen insight and profound knowledge of the subject it was instantly recognized and appraised at its full value. Regretting that the temporary suspension of meetings made it impossible for him to present the paper at once to the Royal Society, Maxwell said he would do the next best thing, which was to send it to the *Philosophical Magazine* for immediate publication, and in that journal it appeared in August, 1873, Maxwell himself having corrected the proofs to avoid delay. The importance of the paper was promptly recognized by European physicists, and abroad, if not at home, Rowland at once took high rank as in investigator.

In this research he unquestionably anticipated all others in the discovery and announcement of the beautifully simple law of the magnetic circuit, the magnetic analogue of Ohm's law, and thus laid the foundation for the accurate measurement and study of magnetic permeability, the importance of which, both in theory and in practice during recent years, it is difficult to overestimate. It has always seemed to me that when consideration is given to his age, his training, and the conditions under which his work was done, this early paper gives a better measure of Rowland's genius than almost any performance of his riper years. During the next year or two he continued to work along the same lines in Troy, publishing not many, but occasional, additions to and developments of his first magnetic research. There was also a paper in which he discussed Kohlrausch's determination of the absolute value of the Siemens unit of electrical resistance, foreshadowing the important part which he was to play in later years in the final establishment of standards for electrical measurement.

In 1875, having been appointed to the professorship of physics in Johns Hopkins University, the faculty of which was just then being organized, he visited Europe, spending the better part of a year in the various centers of scientific activity, including several months at Berlin in the laboratory of the greatest continental physicist of his time, von Helmholtz. While there he made a very important investigation of the magnetic effect of moving electrostatic charges, a question of first rank in theoretical interest and significance. His manner of planning and executing this research made a marked impression upon the distinguished director of the laboratory in which it was done and, indeed, upon all who had any relations with Rowland during its progress. He found what von Helmholtz himself had sought for in vain, and when the investigation was finished in a time which seemed incredibly short to his more deliberate and painstaking associates, the director not only paid it the compliment of an immediate presentation to the Berlin Academy, but voluntarily met all expenses connected with its execution.

The publication of this research added much to Rowland's rapidly growing reputation, and because of that fact, as well as on account of its intrinsic value, it is important to note that his conclusions have been held in question, with varying degrees of confidence, from the day of their announcement to the present. The experiment is one of great difficulty and the effect to be looked for is very small, and therefore likely to be lost among unrecognized instrumental and observational errors. It was characteristic of Rowland's genius that with comparatively crude apparatus he got at the truth of the thing in the very start. Others who have attempted to repeat his work have not been uniformly successful, some of them obtaining a wholly negative result, even when using apparatus apparently more complete and effective than that first employed by Rowland.

Such was the experience of Lecher in 1884, but in 1888 Roentgen confirmed Rowland's experiments, detecting the existence of the alleged effect. The result seeming to be in doubt, Rowland himself, assisted by Hutchinson, in 1889, took it up again, using essentially his original method, but employing more elaborate and sensitive apparatus. They not only confirmed the early experiments, but were able to show that the results were in tolerably close agreement with computed values. The repetition of the experiment by Himstedt in the same year resulted in the same way, but in 1897 the genuineness of the phenomenon was again called in question by a series of experiments made at the suggestion of Lippman, who had proposed a study of the reciprocal of the Rowland effect, according to which variations of a magnetic field should produce a movement of an electrostatically charged body. This investigation, carried out by Crémieu, gave an absolutely negative result, and because the method was entirely different from that employed by Rowland and, therefore, unlikely to be subject to the same systematic errors, it naturally had much weight with those who doubted his original conclusions.

Realizing the necessity for additional evidence in corroboration of his views, in the fall of the year 1900 the problem was again attacked in his own laboratory, and he had the satisfaction, only a short time before his death, of seeing a complete confirmation of the results he had announced a quarter of a century earlier, concerning which, however, there had never been the slightest doubt in his own mind. It is a further satisfaction to his friends to know that a very recent investigation at the Jefferson Physical Laboratory of Harvard University, in which Rowland's methods were modified so as to meet effectively the objections made by his critics, has resulted in a complete verification of his conclusions.

On his return from Europe, in 1876, his time was much occupied with the beginning of the active duties of his professorship, and especially in putting in order the equipment of the laboratory over which he was to preside, much of which he had ordered while in Europe. In its arrangement great (many of his friends thought undue) prominence was given to the workshop, its machinery, tools, and especially the men who were to be employed in it. He planned wisely, however, for he meant to see to it that much, perhaps most, of the work under his direction should be in the nature of original investigation, for the successful execution of which a well manned and equipped workshop is worth more than a storehouse of apparatus already designed and used by others.

He shortly found leisure, however, to plan an elaborate research upon the mechanical equivalent of heat, and to design and supervise the construction of the necessary apparatus for a determination of the numerical value of this most important

physical constant, which he determined should be exhaustive in character and, for some time to come at least, definitive. While this work lacked the elements of originality and boldness of inception by which many of his principal researches are characterized, it was none the less important. While doing over again what others had done before him, he meant to do it, and did do it, on a scale and in a way not before attempted. It was one of the *great* constants of nature, and, besides, the experiment was one surrounded by difficulties so many and so great that few possessed the courage to undertake it with the deliberate expectation of greatly excelling anything before accomplished. These things made it attractive to Rowland.

The overthrow of the materialistic theory of heat, accompanied as it was by the experimental proof of its real nature, namely, that it is essentially molecular energy, laid the foundation for one of those two great generalizations in science which will ever constitute the glory of the nineteenth century. The mechanical equivalent of heat, the number of units of work necessary to raise one pound of water one degree in temperature, has, with much reason, been called the Golden Number of that century. Its determination was begun by an American, Count Rumford, and finished by Rowland, nearly a hundred years later. In principle the method of Rowland was essentially that of Rumford. The first determination was, as we now know, in error by nearly 40 per cent.; the last is probably accurate within a small fraction of 1 per cent. Rumford began the work in the ordnance foundry of the Elector of Bavaria at Munich, converting mechanical energy into heat by means of a blunt boring tool in a cannon surrounded by a definite quantity of water, the rise in temperature of which could be measured. Rowland finished it in an establishment founded for and dedicated to the increase and diffusion of knowledge, aided by all the resources and refinements in measurement which a hundred years of exact science had made possible.

As the mechanical theory of heat was the germ out of which grew the principle of the conservation of energy, an exact determination of the relation of work and heat was necessary to a rigorous proof of that principle, and Joule, of Manchester, to whom belongs more of the credit for this proof than to any other one man or, perhaps, to all others put together, experimented on the mechanical equivalent of heat for more than forty years. He employed various methods, finally recurring to the early method of heating water by friction, improving on Rumford's device by creating friction in the water itself. Joule's last experiments were made in 1878, and most of Rowland's work was done in the year following. It excelled that of Joule, not only in the magnitude of the quantities to be observed, but especially in the greater attention given to the matter of thermometry. In common with Joule and other previous investigators, he made use of mercury thermometers, but this was only for convenience, and they were constantly compared with an air thermometer, the results being finally reduced to the absolute scale. By experimenting with water at different initial temperatures he obtained slightly different values for the mechanical equivalent of heat, thus establishing beyond question the variability of the specific heat of water. Indeed, so carefully and accurately was the experiment worked out that he was able to draw the variation curve and to show the existence of a minimum value at 30 degrees C.

This elaborate and painstaking research, which is now classical, was everywhere awarded high praise. It was published in full by the American Academy of Arts and

Sciences by the aid of a fund originally established by Count Rumford, and in 1881 it was crowned as a prize essay by the Venetian Institute. Its conclusions have stood the test of twenty years of comparison and criticism.

In the meantime, Rowland's interest had been drawn, largely, perhaps, through his association with his then colleague, Professor Hastings, towards the study of light. He was an early and able exponent of Maxwell's magnetic theory, and he published important theoretical discussions of electromagnetic action. Recognizing the paramount importance of the spectrum as a key to the solution of problems in ether physics, he set about improving the methods by which it was produced and studied, and was thus led into what will probably always be regarded as his highest scientific achievement.

At that time the almost universally prevailing method of studying the spectrum was by means of a prism or a train of prisms. But the prismatic spectrum is abnormal, depending for its character largely upon the material made use of. The normal spectrum as produced by a grating of fine wires or a close ruling of fine lines on a plane reflecting or transparent surface had been known for nearly a hundred years, and the colors produced by scratches on polished surfaces were noted by Robert Boyle, more than two hundred years ago. Thomas Young had correctly explained the phenomenon according to the undulatory theory of light, and gratings of fine wire and, later, of rulings on glass, were used by Fraunhofer, who made the first great study of the dark lines of the solar spectrum. Imperfect as these gratings were, Fraunhofer succeeded in making with them some remarkably good measures of the length of light-waves, and it was everywhere admitted that for the most precise spectrum measurements they were indispensable. In their construction, however, there were certain mechanical difficulties which seemed for a time to be insuperable. There was no special trouble in ruling lines as close together as need be; indeed, Nobert, who was long the most successful maker of ruled gratings, had succeeded in putting as many as a hundred thousand in the space of a single inch. The real difficulty was in the lack of uniformity of spacing, and on uniformity depended the perfection and purity of the spectrum produced. Nobert jealously guarded his machine and method of ruling gratings as a trade secret, a precaution hardly worth taking, for before many years the best gratings in the world were made in the United States.

More than thirty years ago an amateur astronomer, in New York City, a lawyer by profession, Lewis M. Rutherfurd, became interested in the subject and built a ruling engine of his own design. In this machine the motion of the plate on which the lines were ruled was produced at first by a somewhat complicated set of levers, for which a carefully made screw was afterwards substituted. Aided by the skill and patience of his mechanician, Chapman, Rutherfurd continued to improve the construction of his machine until he was able to produce gratings on glass and on speculum metal far superior to any made in Europe. The best of them, however, were still faulty in respect to uniformity of spacing, and it was impossible to cover a space exceeding two or three square inches in a satisfactory manner. When Rowland took up the problem, he saw, as, indeed, others had seen before him, that the dominating element of a ruling machine was the screw by means of which the plate or cutting tool was moved along. The ruled grating would repeat all of the irregularities of this screw, and would be good or bad just as these were few or many. The problem was, then, to make a screw which would be practically

free from periodic and other errors, and upon this problem a vast amount of thought and experiment had already been expended.

Rowland's solution of it was characteristic of his genius; there were no easy advances through a series of experiments in which success and failure mingled in varying proportions; 'fire and fall back' was an order which he neither gave nor obeyed, capture by storm being more to his mind. He was by nature a mechanician of the highest type, and he was not long in devising a method for removing the irregularities of a screw, which astonished everybody by its simplicity and by the all but absolute perfection of its results. Indeed, the very first screw made by this process ranks today as the most perfect in the world. But such an engine as this might only be worked up to its highest efficiency under the most favorable physical conditions, and in its installation and use the most careful attention was given to the elimination of errors due to variation of temperature, earth tremors and other disturbances. Not content, however, with perfecting the machinery by which gratings were ruled, Rowland proceeded to improve the form of the grating itself, making the capital discovery of the concave grating, by means of which a large part of the complex and otherwise troublesome optical accessories to the diffraction spectroscope might be dispensed with. Calling to his aid the wonderful skill of Brashear in making and polishing plane and concave surfaces, as well as the ingenuity and patience of Schneider, for so many years his intelligent and loyal assistant at the lathe and work-bench, he began the manufacture and distribution, all too slowly for the anxious demands of the scientific world, of those beautifully simple instruments of precision which have contributed so much to the advance of physical science during the past twenty years.

While willing and anxious to give the widest possible distribution to these gratings, thus giving everywhere a new impetus to optical research, Rowland meant that the principal spoils of the victory should be his, and to this end he constructed a diffraction spectrometer of extraordinary dimensions and began his classical researches on the solar spectrum. Finding photography to be the best means of reproducing the delicate spectral lines shown by the concave grating, he became at once an ardent student and, shortly, a master of that art. The outcome of this was that wonderful 'Photographic Map of the Normal Solar Spectrum,' prepared by the use of concave gratings six inches in diameter and twenty-one and a half feet radius, which is recognized as a standard everywhere in the world. As a natural supplement to this he directed an elaborate investigation of absolute wave-lengths, undertaking to give, finally, the wave-length of not only every line of the solar spectrum, but also of the bright lines of the principal elements, and a large part of this monumental task is already completed, mostly by Rowland's pupils and in his laboratory.

Time will not allow further expositions of the important consequences of his invention of the ruling engine and the concave grating. Indeed, the limitations to which I must submit compel the omission of even brief mention of many interesting and valuable investigations relating to other subjects begun and finished during these years of activity in optical research, many of them by Rowland himself and many of them by his pupils, working out his suggestions and constantly stimulated by his enthusiasm. A list of titles of papers emanating from the Physical Laboratory of the Johns Hopkins University during this period would show somewhat of the great intellectual fertility which its director inspired, and would show, especially, his continued interest in magnetism and electricity, leading to his

important investigations relating to electric units and to his appointment as one of the United States delegates at important international conventions for the better determination and definition of these units. In 1883 a committee appointed by the Electrical Congress of 1881, of which Rowland was a member, adopted 106 centimeters as the length of the mercury column equivalent to the absolute ohm, but this was done against his protest, for his own measurements showed that this was too small by about three-tenths of one per cent. His judgment was confirmed by the Chamber of Delegates of the International Congress of 1893, of which Rowland was himself president, and by which definitive values were given to a system of international units.

Rowland's interest in applied science cannot be passed over, for it was constantly showing itself, often, perhaps, unbidden, an unconscious bursting forth of that strong engineering instinct which was born in him, to which he often referred in familiar discourse and which would unquestionably have brought him great success and distinction had he allowed it to direct the course of his life. Although everywhere looked upon as one of the foremost exponents of pure science, his ability as an engineer received frequent recognition in his appointment as expert and counsel in some of the most important engineering operations in the latter part of the century. He was an inventor, and might easily have taken first rank as such had he chosen to devote himself to that sort of work. During the last few years of his life he was much occupied with the study of alternating electric currents and their application to a system of rapid telegraphy of his own invention. A year ago his system received the award of a grand prix at the Paris Exposition, and only a few weeks after his death the daily papers published cablegrams from Berlin announcing its complete success as tested between Berlin and Hamburg, and also the intention of the German Postal Department to make extensive use of it.

But behind Rowland, the profound scholar and original investigator, the engineer, mechanician and inventor, was Rowland the man, and any estimate of his influence in promoting the interests of physical science during the last quarter of the nineteenth century would be quite inadequate if not made from that point of view. Born at Honesdale, Pennsylvania, on November 27, 1848, he had the misfortune, at the age of eleven years, to lose his father by death. This loss was made good, as far as it is possible to do so, by the loving care of mother and sisters during the years of his boyhood and youthful manhood. From his father he inherited his love for scientific study, which from the very first seems to have dominated all his aspirations, directing and controlling most of his thoughts. His father, grandfather and great-grandfather were all clergymen and graduates of Yale College. His father, who is described as one 'interested in chemistry and natural philosophy, a lover of nature and a successful trout-fisherman,' had felt, in his early youth, some of the desires and ambitions that afterward determined the career of his distinguished son, but yielding, no doubt, to the influence of family tradition and desire, he followed the lead of his ancestors.

It is not unlikely, and it would not have been unreasonable, that similar hopes were entertained in regard to the future of young Henry, and his preparatory-school work was arranged with this in view. Before being sent away from home, however, he had quite given himself up to chemical experiments, glass-blowing and other similar occupations, and the members of his family were often summoned by the enthusiastic boy to listen to lectures which were fully

illustrated by experiments, not always free from prospective danger. His spare change was invested in copper wire and the like, and his first five-dollar bill brought him, to his infinite delight, a small galvanic battery. The sheets of the *New York Observer*, a treasured family newspaper, he converted into a huge hot-air balloon, which, to the astonishment of his family and friends, made a brilliant ascent and flight, coming to rest, at last, and in flames, on the roof of a neighboring house, and resulting in the calling out of the entire fire department of the town. When urged by his boy friends to hide himself from the rather threatening consequences of his first experiment in aeronautics, he courageously marched himself to the place where his balloon had fallen, saying, 'No! I will go and see what damage I have done.'

When a little more than sixteen years old, in the spring of 1865, he was sent to Phillips Academy at Andover, to be fitted for entering the academic course at Yale. His time there was given entirely to the study of Latin and Greek, and he was in every way out of harmony with his environment. He seems to have quickly and thoroughly appreciated this fact, and his very first letter from Andover is a cry for relief. '*Oh, take me home!*' is the boyish scrawl covering the last page of that letter, on another of which he says, 'It is simply horrible; I can never get on here.' It was not that he could not learn Latin and Greek if he was so minded, but that he had long ago become wholly absorbed in the love of nature and in the study of nature's laws, and the whole situation was to his ambitious spirit most artificial and irksome. Time did not soften his feelings or lessen his desire to escape from such uncongenial surroundings, and, at his own request, Dr. Farrand, principal of the academy at New Jersey, to which city the family had recently removed, was consulted as to what ought to be done. Fortunately for everybody, his advice was that the boy ought to be allowed to follow his bent, and, at his own suggestion, he was sent, in the autumn of that year, to the Rensselaer Polytechnic Institute at Troy, where he remained five years, and from which he was graduated as a civil engineer in 1870.

It is unnecessary to say that this change was joyfully welcomed by young Rowland. At Andover the only opportunity that had offered for the exercise of his skill as a mechanic was in the construction of a somewhat complicated device by means of which he outwitted some of his schoolmates in an early attempt to haze him, and in this he took no little pride. At Troy he gave loose rein to his ardent desires, and his career in science may almost be said to begin with his entrance upon his work there and before he was seventeen years old.

He made immediate use of the opportunities afforded in Troy and its neighborhood for the examination of machinery and manufacturing processes, and one of his earliest letters to his friends contained a clear and detailed description of the operation of making railroad iron, the rolls, shears, saws and other special machines being represented in uncommonly well executed pen drawings. One can easily see in this letter a full confirmation of a statement that he occasionally made later in life, namely, that he had never seen a machine, however complicated it might be, whose working he could not at once comprehend. In another letter, written within a few weeks of his arrival in Troy, he shows in a remarkable way his power of going to the root of things which even at that early age was sufficiently in evidence to mark him for future distinction as a natural philosopher. On the river he saw two boats equipped with steam pumps, engaged in trying to raise a half-sunken canal boat by pumping the water out of it.

He described engines, pumps, etc., in much detail, and adds, "But there was one thing that I did not like about it; they had the end of their discharge pipe about ten feet above the water, so that they had to overcome a pressure of about five pounds to the square inch to raise the water so high, and yet they let it go after they got it there, whereas if they had attached a pipe to the end of the discharge pipe and let it hang down into the water, the pressure of water on that pipe would just have balanced the five pounds to the square inch in the other, so that they could have used larger pumps with the same engines and thus have got more water out in a given time."

The facilities for learning physics, in his day, at the Rensselaer Polytechnic Institute were none of the best, a fact which is made the subject of keen criticism in his home correspondence, but he made the most of whatever was available and created opportunity where it was lacking. The use of a turning-lathe and a few tools being allowed, he spent all of his leisure in designing and constructing physical apparatus of various kinds with which he experimented continually. All of his spare money goes into this and he is always wishing he had more. While he pays without grumbling his share of the expense of a class supper, he cannot help declaring that 'it is an *awful* price for one night's pleasure; why, it would buy another galvanic battery.' During these early years his pastime was the study of magnetism and electricity, and his lack of money for the purchase of insulated wire for electromagnetic apparatus led him to the invention of a method of winding naked copper wire, which was later patented by some one else and made much of. Within six months of his entering the Institute he had made a delicate balance, a galvanometer and an electrometer, besides a small induction coil and several minor pieces. A few weeks later he announces the finishing of a Ruhmkorff coil of considerable power, a source of much delight to him and to his friends.

In December, 1866, he began the construction of a small but elaborately designed steam engine which ran perfectly when completed and furnished power for his experiments. A year later he is full of enthusiasm over an investigation which he wishes to undertake to explain the production of electricity when water comes in contact with red-hot iron, which he attributes to the decomposition of a part of the water. Along with all this and much more he maintains a good standing in his regular work in the Institute, in some of which he is naturally the leader. He occasionally writes: 'I am head of my class in mathematics,' or 'I lead the class in natural philosophy,' but official records show that he was now and then 'conditioned' in subjects in which he had no special interest. As early as 1868, before his twentieth birthday, he decided that he must devote his life to science. While not doubting his ability 'to make an excellent engineer,' as he declares, he decides against engineering, saying: "You know that from a child I have been extremely fond of experiment; this liking, instead of decreasing, has gradually grown upon me until it has become a part of my nature, and it would be folly for me to attempt to give it up; and I don't see any reason why I should wish it unless it be avarice, for I never expect to be a rich man. I intend to devote myself hereafter to *science*. If she gives me wealth I will receive it as coming from a friend, but if not, I will not murmur."

He realized that his opportunity for the pursuit of science was in becoming a teacher, but no opening in this direction presenting itself, he spent the first year after graduation in the field as a civil engineer. This was followed by a not very inspiring experience as instructor in natural science in

a western college, where he acquired, however, experience and useful discipline.

In the spring of 1872 he returned to Troy as instructor in physics, on a salary the amount of which he made conditional on the purchase by the Institute of a certain number of hundreds of dollars' worth of physical apparatus. If they failed in this, as afterward happened, his pay was to be greater, and he strictly held them to the contract. His three years at Troy as instructor and assistant professor were busy, fruitful years. In addition to his regular work he did an enormous amount of study, purchasing for that purpose the most recent and most advanced books on mathematics and physics. He built his electro-dynamometer and carried out his first great research. As already stated, this quickly brought him reputation in Europe and, what he prized quite as highly, the personal friendship of Maxwell, whose ardent admirer and champion he remained to the end of his life. In April, 1875, he wrote, "It will not be very long before my reputation reaches this country," and he hoped that this would bring him opportunity to devote more of his time and energy to original research.

This opportunity for which he so much longed was nearer at hand than he imagined. Among the members of the Visiting Board at the West Point Military Academy in June, 1875, was one to whom had come the splendid conception of what was to be at once a revelation and a revolution in methods of higher education. In selecting the first faculty for an institution of learning which, within a single decade, was to set the pace for real university work in America, and whose influence was to be felt in every school and college of the land before the end of the first quarter of a century, Dr. Gilman was guided by an instinct which more than all else insured the success of the new enterprise. A few words about Rowland from Professor Michie, of the Military Academy, led to his being called to West Point by telegraph, and on the banks of the Hudson these two walked and talked, 'he telling me,' Dr. Gilman has said, 'his dreams for science, and I telling him my dreams for higher education.' Rowland, with characteristic frankness, writes of this interview, 'Professor Gilman was very much pleased with me,' which, indeed, was the simple truth. The engagement was quickly made. Rowland was sent to Europe to study laboratories and purchase apparatus, and the rest is history, already told and everywhere known.

Rowland's personality was in many respects remarkable. Tall, erect and lithe in figure, fond of athletic sports, there was upon his face a certain look of severity which was, in a way, an index of the exacting standard he set for himself and others. It did not conceal, however, what was, after all, his most striking characteristic, namely, a perfectly frank, open and simple straightforwardness in thought, in speech and in action. His love of truth held him in supreme control, and, like Galileo, he had no patience with those who try to make things appear otherwise than as they actually are. His criticisms of the work of others were keen and merciless, and sometimes there remained a sting of which he himself had not the slightest suspicion. 'I would not have done it for the world,' he once said to me after being told that his pitiless criticism of a scientific paper had wounded the feelings of its author. As a matter of fact, he was warm-hearted and generous, and his occasionally seeming otherwise was due to the complete separation, in his own mind, of the product and the personality of the author. He possessed that rare power, habit in his case, of seeing himself, not as others see him, but as he saw others. He looked at himself and his own work exactly

as if he had been another person, and this gave rise to a frankness of expression regarding his own performance which sometimes impressed strangers unpleasantly, but which, to his friends, was one of his most charming qualities.

Much of his success as an investigator was due to a firm confidence in his own powers, and in the unerring course of the logic of science which inspired him to cling tenaciously to an idea when once he had given it a place in his mind. At a meeting of the National Academy of Sciences in the early days of our knowledge of electric generators he read a paper relating to the fundamental principles of the dynamo. A gentleman who had had large experience with the practical working of dynamos listened to the paper, and at the end said to the academy that unfortunately practice directly contradicted Professor Rowland's theory, to which instantly replied Rowland, 'So much the worse for the practice,' which, indeed, turned out to be the case.

Like all men of real genius, he had phenomenal capacity for concentration of thought and effort. Of this, one who was long and intimately associated with him remarks, "I can remember cases when he appeared as if drugged from mere inability to recall his mind from the pursuit of all-absorbing problems, and he had a triumphant joy in intellectual achievement such as we would look for in other men only from the gratification of an elemental passion." So completely consumed was he by fires of his own kindling that he often failed to give due attention to the work of others, and some of his public utterances give evidence of this curious neglect of the historic side of his subject.

As a teacher his position was quite unique. Unfit for the ordinary routine work of the class room, he taught, as more men ought to teach, by example rather than by precept. Says one of his most eminent pupils, "Even of the more advanced students, only those who were able to brook severe and searching criticism reaped the full benefit of being under him, but he contributed that which in a university is above all teaching of routine, the spectacle of scientific work thoroughly done and the example of a lofty ideal."

Returning home about twenty years ago, after an expatriation of several years, and wishing to put myself in touch with the development of methods of instruction in physics, and especially in the equipment of physical laboratories, I visited Rowland very soon after, as it happened, the making of his first successful negative of the solar spectrum. That he was completely absorbed in his success was quite evident, but he also seemed anxious to give me such information as I sought. I questioned him as to the number of men who were to work in his laboratory, and although the college year had already begun he appeared to be unable to give even an approximate answer. 'And what will you do with them?' I said. 'Do with them?' he replied, raising the still dripping negative so as to get a better light through its delicate tracings, 'Do with them?—*I shall neglect them.*' The whole situation was intensely characteristic, revealing him as one to whom the work of a drill-master was impossible, but ready to lead those who would be led and could follow. To be neglected by Rowland was often, indeed, more stimulating and inspiring than the closest personal supervision of men lacking his genius and magnetic fervor.

In the fulness of his powers, recognized as America's greatest physicist, and one of a very small group of the world's most eminent, he died on April 16, 1901, from a disease, the relentless progress of which he had realized for several years and opposed with a splendid but quiet courage.

It was Rowland's good fortune to receive

recognition during his life in the bestowal of degrees by higher institutions of learning; in election to membership in nearly all scientific societies worthy of note in Europe and America; in being made the recipient of medals of honor awarded by these societies, and in the generously expressed words of his distinguished contemporaries. It will be many years, however, before full measure can be had of his influence in promoting the interests of physical science, for with his own brilliant career, sufficient of itself to excite our profound admiration, must be considered that of a host of other younger men who lighted their torches at his flame and who will reflect honor upon him whose loss they now mourn, by passing on something of his unquenchable enthusiasm, something of his high regard for pure intellectuality, something of his love of truth and his sweetness of character and disposition.

T. C. MENDENHALL.

REPORT OF THE BOARD OF VISITORS TO THE NAVAL OBSERVATORY FOR THE YEAR 1901.

IN pursuance to a call issued by the Secretary of the Navy, a meeting of the Board of Visitors to the Naval Observatory was held in Washington, beginning April 9, 1901. The Board was organized by the selection of Charles A. Young as chairman and Ormond Stone as secretary. Another meeting was held in Washington, beginning October 29, 1901. At both of these meetings, and afterwards by correspondence, as careful an examination as time permitted was made, directly and by committee, of the condition and needs of the Observatory, and of such other matters as are referred to in the law creating the Board. In this examination the Board was greatly aided by conferences with the Secretary of the Navy, the Superintendent and staff of the Naval Observatory, officers of the Civil Service Commission, and others, all of whom have given the Board their most cheerful assistance. As a result of the deliberations of the Board the following recommendations are respectfully offered for consideration:

ASTRONOMICAL DIRECTOR.

It is recommended that no astronomical director be appointed at present, as a dual headship has been found to work unsatisfactorily, and under the existing law the appointment of an astronomer as sole director of the Observatory—which the Board considers the proper solution of the question—is impracticable.

METHOD OF FILLING VACANCIES.

Vacancies should not be filled among assistant astronomers nor among professors of mathematics in the Navy without examination for each vacancy occurring. For example, the results of a given examination should not be used for filling a subsequent vacancy, except in so far as such results may properly form a part of a new independent examination. No distinction should be made between employees of the Observatory and other applicants. Employees should, however, of course, be at liberty to present evidence of experience or capacity as shown by their work at the Observatory in the same manner as other candidates present similar evidence as shown by their work elsewhere. The responsibilities of the positions of assistant astronomer and professor of mathematics are distinctly different from those of a computer, although much of the required experience may properly be gained in connection with the latter position and be credited in the examinations for the higher positions. At the same time it is important that the positions of computer should be filled by persons whose prime interest is in practical and theoretical astronomy and whose ambition it will be to occupy higher positions in the Observatory. As far as is

consistent with the routine needs of the institution, the duties of the computers should be so arranged as to encourage them to prepare for advancement within the Observatory itself. The positions of piece-work and of regular computers are essentially of the same nature, and promotion from one of these grades to the other may very properly be made, but always on the basis of merit rather than length of service. In no case should appointments be made to the Observatory merely by transfer from other bureaus or offices in the service, nor should appointments ever be made even temporarily without competitive examination.

ASSISTANT ASTRONOMERS.

In accordance with the principles herein stated, instead of recommending the name of a person to fill the vacancy now existing among the assistant astronomers at the Naval Observatory, we recommend that an examination be held with the assistance of the Civil Service Commission, in accordance with an announcement, a copy of which accompanies this report as Exhibit A, the examiners to be the members of the Board of Visitors for the time being. In order to carry this out, it is requested that Departmental Order No. 14 be so modified that employees of the Naval Observatory may have the same right to apply as other persons.

ADMINISTRATION OF THE OBSERVATORY.

We desire to call attention to the fact that the enactment which created the Board of Visitors provides that "the Superintendent of the Naval Observatory shall be, until further legislation by Congress, a line officer of the Navy of a rank not below that of captain," thus implying that a change in the law is in contemplation. As every other prominent observatory is under the direction of an astronomer, we wish to record our deliberate and unanimous judgment that the law should be changed so as to provide that the official head of the Observatory—perhaps styled simply 'the director'—should be an eminent astronomer appointed by the President, by and with the advice and consent of the Senate, holding this place by a tenure at least as permanent as that of the superintendent of the Coast Survey, or the head of the Geological Survey, and not merely by a detail of two or three years' duration. Only in this way can there be a continuous and effective policy of administration which will insure astronomical work of a high order. In rank, salary, privilege and prestige he should be superior to any other official on the ground.

The limitation in the selection of assistants should also be removed, and the assistant once appointed should be secure against detachment or removal except by the action, for cause, of the director.

The institution should be related to the Navy Department, if continued under its control, in some such way as the Royal Observatory at Greenwich is related to the British Admiralty. It should be put under the control of the Secretary directly, and not through a bureau as at present.

SCOPE AND PLAN OF WORK.

The relation of the United States Naval Observatory to astronomy is unlike that of any other observatory in the country. A private observatory is usually devoted to a special line of work selected by its director, or by the head of one of its departments. This work is then carried on in the manner and in the special directions chosen by the officer in charge. The Naval Observatory, on the other hand, is maintained at the expense of all the people of the United States, and its work should not be entirely determined by the wishes and interests of any one individual; a principal use should be to supply the wants of astronomy by undertaking researches which have been

neglected elsewhere, either because they are too expensive or for other reasons. It is believed that the policy of undertaking neglected work, and doing what is most needed and not what is most attractive, would commend itself to Congress, to astronomers and to the people.

The Naval Observatory should cooperate with the other observatories of the country, use its influence to prevent needless duplication of work, and supply important deficiencies in work done elsewhere.

Great care should be taken in preparing a permanent scheme of work in the preparation of which the opinions of experts in each department should be carefully considered.

Important changes in such a plan should be made only after careful consideration, and should in general relate to details of observation, reduction and form of publication, rather than to objects or classes of investigation. The officers required to carry out this work should be selected for special fitness or experience, as well as for general astronomical knowledge, and a change in duty should be seldom made and then only for important reasons. If any observer has by years of experience attained great skill with a meridian circle, to place him in charge of an equatorial would be much like making a sailing master of an engineer, however skilled he may be. Great care should be taken in the assignment of duties to different members of the observing staff in order to secure a satisfactory distribution of force among the instruments and to avoid undue concentration or the reverse. At the same time the special aptitudes of individuals should be kept in mind, and their interest enlisted by giving them as far as possible independence of responsibility.

The following provisional plan is suggested for criticism and amendment:

The meridian circle is necessarily one of the most important instruments in a government observatory. Daily observations should be made, whenever possible, of the sun and moon, and of sufficient number of standard stars to determine accurately the error of the standard clock and the constants of the instrument. The major planets should be observed on a certain number of nights every year to correct their ephemerides, but not often enough to curtail seriously the other work of the instrument. A system of standard stars should be selected by cooperation with the various national almanacs and observatories, and a certain number of observations of each of these stars should, if possible, be secured each year. In planning the observations, the determination of their absolute and not merely their relative positions should be taken into consideration. In preparing a list of standard stars it is suggested that instead of attempting to observe all stars brighter than a given magnitude, it might be better to take only those of about the same magnitude and spectrum, in order to eliminate errors due to magnitude and color, and to choose those nearly equally spaced in the sky, adding such polar and equatorial stars as will culminate at nearly equal intervals and will not interfere with one another. It would also be necessary to include all the very bright stars as a basis for daylight observations. As examples of special researches that might have been taken up under such a system may be mentioned the comparison stars for Victoria and Sappho proposed by Dr. Gill in 1889, and the comparison stars selected by the Astrophotographic Conference of 1900 for observations of Eros.

The altazimuth instrument should perhaps also be used for observing the moon when off the meridian, and for determining the time when clouds render it impossible to observe on the meridian. The observation of zenith stars should be continued

with the prime vertical instrument and vertical circle. These observations, which appear to be of a high degree of excellence, have now lasted eight years, and should be maintained for at least eleven years longer, or through a complete metonic cycle, to furnish a good determination of the constant of nutation. An additional computer is much needed for the reduction of this work.

The determination and distribution of accurate time will always be an important function of a government observatory, and requires a careful administration. Not only is the exact time required for rating the chronometers of the Navy, but at present time signals are distributed by telegraph from the Naval Observatory throughout the country. The value of accurate time to the people generally is so great that no reasonable effort should be spared to reduce the inevitable errors from every source as much as possible. Formerly large sums were expended by railroads, cities, factories and makers of clocks and watches in the purchase of time signals, furnished by various observatories. To many observatories this was an important source of income.

In 1883 the astronomers of the country, recognizing the great value of a system of uniform standard time, used all their influence toward securing its adoption, notwithstanding the obvious danger to their private interests—since under such a system it would be possible for a single institution to furnish time to the whole country. In fact, in 1891 the Naval Observatory assumed the task. While the time as now distributed from the Observatory is sufficiently accurate for most business purposes, since a nonaccumulating error of a few seconds is of little importance in that view, it appears, however, that at considerable distances from Washington the errors are often considerably greater than under the old system, when the time was communicated from a standard clock not very far away, the errors being often large enough to interfere with the utility of the signals for chronometer rating and scientific purposes. The difficulty lies largely in the methods by which the time is transmitted by the telegraph, but more in the slightly irregular rate of the standard clock through long intervals of cloudy weather during which star observations cannot be obtained.

It would seem that by cooperation with other observatories a considerable improvement might be made, by arranging matters so that every night, or at least on nights during which the weather is bad at Washington, these observatories should each send a time signal to the Naval Observatory, indicating also the interval since the last observation.

It is difficult to see any way in which the efficiency of the Navy is increased by means of the 26-inch equatorial telescope. If left idle, however, it would be a subject for severe criticism, owing to the large sums of money already expended upon it. Its work should, therefore, be planned wholly in the interests of astronomy. The same principle should be adopted as with the other instruments. Researches should be undertaken which have been neglected at other observatories, duplication of work should be carefully avoided, and no investigation should be undertaken that can be done equally well with smaller instruments. The following examples of the species of work to be undertaken may be mentioned: A list of double stars which are too difficult to be observed with small instruments, and of which no recent accurate measures have been made, should be prepared with the advice of specialists in this department, and measured with the greatest accuracy; binaries and suspected binaries should, of course, receive special attention; neglected

asteroids and variables should similarly be followed; the observations of the satellites should be continued with this instrument, especially those of Saturn and Uranus, which are likely to be neglected at European observatories for the next few years owing to their southern declinations.

Lost asteroids, and perhaps others, can best be found and followed by photography. The spectroscopic approach and recession of the stars is at the present time under investigation with so many very large telescopes that this work may be left to them. The number of known spectroscopic binaries, however, is so great that it may be necessary hereafter to follow them carefully to determine the laws governing their motions. The work of the 12-inch equatorial should supplement that of the 26-inch.

In general the plan of work should be altered but rarely, and then only when changes seem imperative. Special attention should be given to work neglected elsewhere, and every effort made to render our knowledge of astronomy as complete as possible.

AMERICAN EPHEMERIS AND NAUTICAL ALMANAC.

Among the most important scientific publications of the Government of the United States are those issued by the Office of the American Ephemeris and Nautical Almanac. The first and best known is the Almanac issued every year, which gives name to the office. Four European countries—Great Britain, Germany, France and Spain—make similar publications, and a great saving might be effected by carrying still further the plan of cooperation already in part adopted. To avoid errors certain elements are computed independently three times, but if this is done for all five of the almanacs evidently much work is wasted. So far as possible the same quantities should be published in all of the almanacs, and computed independently as many times as may be deemed necessary. Ninety-six pages are devoted to that important and laborious problem, the exact path of the moon. Here an independent computation seems needless when we consider that the only American observatory at which the position is regularly determined is at Washington. The occasional observations made at other places have, in general, but little permanent value, and for observations of the moon at sea far less accurate positions are needed. In fact, 72 additional pages are devoted to lunar distances. In order that the saving suggested may be accomplished without delaying the publication of the Almanac, arrangements should be made with the foreign almanac offices to complete their computations at least a year longer in advance than is done at present.

A second most important consideration is that changes should be made only after a most careful examination and consultation with astronomers for whose benefit the Almanac is printed, and with the approval of the Board of Visitors. Changes not only cause great inconvenience, but often render it necessary to employ some other almanac when reducing the observations extending over a long period of years. The changes suggested below are so extensive that they should be made only if approved by American astronomers in general.

Washington mean time is not used even at Washington, and its use in the Almanac seems superfluous. Greenwich mean time, as modified in standard time, is in universal use in the United States, and is already used in a large part of the Almanac. Central time, which differs from Greenwich time by exactly six hours, might be conveniently used to simplify the interpolation for the transits of the moon and planets.

The phase angle, *i*, should be given for

the outer planets as well as for Mercury and Venus.

The ephemerides of the satellites are often insufficient for even the identification of these bodies. This is particularly the case with Hyperion and Iapetus. For the latter even the apparent ellipse is not given. It will probably not be necessary to return to the bulky tables of the satellites of Jupiter, published yearly in the Almanac before 1882. It would be convenient to have the correction to the ephemeris given when it is known—for instance, the ephemeris of Mimas for this year (1901) is in error by about four hours. Accordingly it is invisible on account of the ring at the predicted times of elongation.

The published positions of observatories should be changed only after careful consultation with the directors. If a system of longitude like that of the Coast Survey is adopted, it should be so stated in the description. The statement that 'the latest available data have been used' is too indefinite.

A great saving in expense might be effected by the adoption of some of the changes mentioned above. This would permit the insertion of valuable data now omitted. For instance, the list of star places might be greatly extended, ephemerides for physical observations of the moon and planets might be inserted, and approximate ephemerides of Eros and of some of the more interesting asteroids, such as Hungaria, Tercidina, Sirona and Polyhymnia.

It is recommended that these and similar changes be proposed to astronomers, and that they be invited to suggest others, as was done by Professor Newcomb when taking charge of the office.

A series of papers of very great scientific value, entitled 'Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac,' has been issued by this office during the last twenty years. The 'Contribution to Celestial Mechanics,' made while the office was under the direction of Professor Newcomb, was a notable one, and a continuation of the papers mentioned is greatly to be desired. A continued investigation of the motion of the moon is especially recommended.

INSTRUMENTS.

The Board at its meeting in April appointed a committee which made as careful an inspection of the instruments of the Observatory as was possible during the time at its disposal. On the whole, the 26-inch equatorial is in good condition. It is recommended that this instrument be supplied with a micrometer at least equal in quality to that constructed for the large equatorial of the Pulkowa Observatory. Also a good field illumination should be provided, as well as a symmetrical illumination for the wires.

Since the visit of the committee in April a number of improvements have been made on the 12-inch equatorial; a bright field illumination is still needed. An investigation of the object glass, which gives poor stellar images, is now in progress by Mr. King, the officer in charge. This examination will show whether the glass is merely out of adjustment or should be refigured.

Extensive repairs are needed for the 9-inch transit circle, and especial attention is invited to Exhibit B, which gives a list of the most important improvements referred to.

A number of changes have been made in the 6-inch transit circle; these and others still needed are referred to in Exhibit C. For both transit circles collimators should be provided having object glasses of larger apertures, and also better means should be provided for obtaining the necessary meteorological data.

The prime vertical transit should be pro-

vided with a long focus lens and an azimuth mark. The house containing the altazimuth is too small. The present building should be replaced by one of such size that collimators may be placed inside of the dome, and, as in the case of the prime vertical, a long focus lens and an azimuth mark should be provided.

For use with the meridian and prime vertical instruments three new chronographs are needed.

Special attention is called to the importance of a careful study of each instrument of the Observatory and a prompt publication of the results of such investigations.

LIBRARY.

The Library contains 18,025 bound volumes and 3,891 pamphlets. It is devoted to astronomy and mathematics, and the allied sciences, and is particularly rich in complete sets of the publications of observations, academies, and learned societies of Europe, many of which are rare as well as modern treatises and reports of investigations. It is admirably arranged and is in excellent order. The assistant librarian in charge has made considerable progress in the preparation of a comprehensive card catalogue, which will render the material on the shelves much more available.

The appropriation of $750, which is now provided for the Library, is not sufficient for its needs. About $350 of this is required to keep up the scientific journals and the works, such as yearbooks, which appear periodically. The remainder of the appropriation is not sufficient to provide the new books, engravings, photographs, and fixtures required, and to fill up gaps in the Library when special opportunity offers. It is recommended that the appropriation be increased to $1,000.

ADDITIONAL REQUIREMENTS.

In the opinion of the Board, there is urgently needed—

1. A repair shop for the instrument maker.

2. Residences for those who are regularly engaged in late night observations.

EXPENDITURES.

The expenditures for the Naval Observatory are presented in Exhibit D.

From the manner in which the appropriations have been made, it is not easy for the Board of Visitors to determine what portion of the expenditures pertains properly to astronomical work, what portion to naval work, and what portion to the improvement and care of the grounds as a park.

Respectfully submitted.

CHAS. A. YOUNG,
CHAS. F. CHANDLER,
ASAPH HALL, JR.,
E. C. PICKERING,
ORMOND STONE,
WILLIAM R. HARPER.

THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

THE fifteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations was held at Washington, D. C., November 12 to 14. President A. W. Harris, of the University of Maine, presided at the general sessions and delivered the president's annual address. This address set forth clearly the more important things for which the land-grant colleges stand and summarized the results of their work. The land grant act of 1862 was considered important not only as providing for agricultural education, but as the first sufficient recognition of study and investigation as the basis of the best success in the arts and industries. It also proclaimed the duty of the national government to promote industrial education, and in its results demonstrated the effectiveness

of governmental cooperation. The most important of the direct results of this act to agriculture was the experiment station. "If the agricultural college did nothing more than to establish, maintain, and officer the experiment station, it would be justified many times over." The establishment of the agricultural colleges also caused the strengthening and broadening of industrial education along all lines and has culminated in a great system of technical education. "It is also a great result of the land-grant college to have asserted and established the doctrine that education in all its forms, from the lowest to the highest, is a State function in which the State has the fullest rights and for which it must bear the responsibility, sharing the privilege and responsibility with private corporations only as it thinks best." The speaker considered state aid and control in higher education as necessary to the best national development, and especially so because in this way the results of higher education become the property of all the people. The address concluded with an eloquent tribute to the memory and worth of Justin S. Morrill.

The report of the Executive Committee presented by its chairman, President H. H. Goodell, of the Massachusetts Agricultural College, called the attention of the Association to the fact that the bill for the establishment of schools or departments of mining and metallurgy in connection with the land-grant colleges passed the Senate, but failed to be called up in the House of Representatives during the last session of Congress. The introduction of a similar bill into Congress early in its next session was recommended.

The report of the Committee on Revision of the Constitution called forth a vigorous discussion. The Association refused to change its name. Among the important amendments adopted were those providing that the election of officers shall be by ballot upon nominations made on the floor of the convention, and that the program of the annual conventions of the Association shall hereafter be made up and distributed sixty days before the meeting of the convention; and "the subjects provided for consideration by a section at any convention of the Association shall concentrate the deliberations of the section upon not more than two main lines of discussion, which lines shall so far as possible be related. Not more than one-third of the working time of any annual convention of the Association shall be assigned to miscellaneous business."

The Committee on Graduate Study at Washington reported that no progress had been made since the last convention in securing a Government bureau in Washington for the administration of graduate work. The Association directed the committee to continue its efforts in this direction and, in the meantime, to secure if practicable the same opportunities for study and research in other departments of the government as are at present afforded graduate students in the Department of Agriculture. A resolution was also adopted by the Association recording its appreciation of the action of the government in making available the facilities for research and advanced work in the Department of Agriculture, and expressing a desire that these facilities may be still further extended and that a national university devoted exclusively to advanced study and graduate and research work be established.

The sixth report of progress was submitted by the Committee on Methods of Teaching Agriculture. Attention was called to the publication by the Department of Agriculture of the syllabi of courses in agrotechny, rural engineering and rural economics prepared by the committee last year. In surveying the progress of agricultural education in this country during re-

cent years the committee "found abundant evidence that the attitude of this Association and the work of this committee as its representative have already borne good fruit in stimulating and aiding the movement for the specialization of agricultural instruction in our colleges, the strengthening of agricultural faculties, and the bettering of the material equipment for agricultural education." The committee announced its intention to prepare and publish during the coming year a report on the courses in agronomy in our agricultural colleges and the facilities for instruction in this subject.

The Committee on Cooperative Work between the Stations and the Department of Agriculture made the following recommendations as supplementary to those embodied in the report submitted at the last convention: "(1) When cooperation is desired by the station it is deemed advisable that the proposal for such cooperation be made to the department by the director of the experiment station; where on the other hand the department desires the cooperation of the station, it is deemed advisable that the proposal be made in the first instance to the director rather than to members of the staff. (2) While it is well understood that no financial obligations can be undertaken beyond the end of the fiscal year, yet it should be recognized that any arrangement for joint experimentation which requires some years to complete creates a moral obligation upon both parties to carry the work to a conclusion. (3) Where a line of investigation has been in progress in any State under the auspices of either institution it is, as a rule, unwise for the other party to undertake independently the same line of investigation at least until after full consultation upon the subject."

The committee was continued with the addition of Professor B. T. Galloway of the Department of Agriculture.

The report of the Committee on Indexing Agricultural Literature called attention to the fact that progress in this direction could not be made by the Department of Agriculture until its library was provided with funds for this purpose. A paper on 'Agricultural College Libraries,' prepared and presented by Miss Josephine A. Clark, librarian of the Department of Agriculture, and a member of this committee, completed the report. This paper emphasized the great importance of libraries as aids to the work of investigation and instruction and pointed out the necessity of systematic arrangement and complete cataloguing of agricultural libraries. Arrangements in progress by the library of the Department for assisting agricultural colleges in classifying and cataloguing their libraries were explained.

The report of the bibliographer, A. C. True, noted the work of a bibliographical character being done by the Department of Agriculture, and enumerated with explanatory notes forty-four general and partial bibliographies in lines relating to agriculture issued during the past year.

The general plan of the graduate summer school of agriculture, as proposed by the Ohio State University at the last convention and approved by the Executive Committee, was explained by President W. O. Thompson of the University. It was stated that sufficient encouragement had been received from the leaders of agricultural education and research to warrant a decision to hold the first session of the school at the Ohio State University at Columbus, Ohio, during the summer of 1902. It was announced that Secretary Wilson had cordially approved the plan for this school, and that, acting under his advice, Doctor A. C. True, director of the Office of Experiment Stations, had consented to act as dean of the school. The Ohio State University makes itself responsible for the general management of the first session of

the school, but if it proves a success it is proposed to make it a cooperative enterprise, to be managed by a committee of control appointed by the Association. Future sessions may be held at institutions in different parts of the country. This plan for the school was endorsed by the Association and a prospectus of the first session will soon be issued.

The Association voted in favor of exhibits illustrating the progress of instruction and research in agriculture and the mechanic arts, at the St. Louis Exposition in 1903, and committees on these exhibits were appointed.

The resolution introduced by Professor W. A. Henry, of Wisconsin, was adopted by the Association, urging upon Congress "the necessity and wisdom of providing a building for the accommodation of the Department of Agriculture which in magnitude shall be sufficient to provide for its future, as well as present, needs, and which will properly represent in its architecture the enormous importance of agriculture in this country, and which will constitute a worthy addition to the government buildings of the capital of the United States."

In the section on college work a paper on the relation of agricultural colleges to the proposed national university, by President W. O. Thompson, of the Ohio State University, was presented in which the writer affirmed that in his judgment "the relation of the agricultural colleges to a national university should be that of sympathetic cooperation and enthusiastic support, as against all other measures whether proposed as substitutes or stepping-stones." This paper called forth a lively discussion in which it appeared that there was a general sentiment in the section in favor of securing some agency under government control for making the laboratories, museums, libraries, and other educational facilities in Washington available to advanced students.

W. M. Liggett, Dean of the College of Agriculture of the University of Minnesota, read a paper on the value of short courses, in which he described the different courses in agriculture given in Minnesota, and stated that he considered the short courses valuable adjuncts to the longer courses.

Honorable J. H. Brigham, Assistant Secretary of Agriculture, spoke of the short courses as a means not only of giving valuable instruction to farmers, but also of bringing about more cordial relations between the agricultural colleges and farmers. In his judgment "the best way to secure the support of farmers is to let them come to the college even for a short time and see that you are trying to do good."

In the section on agriculture and chemistry considerable time was given to a consideration of the question to what extent the Department of Agriculture and the experiment stations may profitably cooperate in the study of grass and forage plant problems and the lines of work which are likely to yield the most important results. Professor B. T. Galloway, chief of the Bureau of Plant Industry, gave a brief history of the cooperative forage plant work of the Department and the stations. He expressed his opinion that the success of the movement depended on grouping the stations with reference to the problems to be solved in different sections of the country, and devising a working plan for each group. The following lines of work were suggested: (1) The introduction of crops from foreign countries, (2) growing and disseminating introduced crops after they have become in a measure established, (3) dissemination of native crops of local value, (4) breeding crops for certain conditions, (5) increasing production by improved cultural methods. Professor R. H. Forbes, director of the Arizona Experimental Station, described the grass and forage crop conditions of that Territory, and gave an account of the co-

operative investigations carried on there. These investigations have for their object the improvement of the ranges through the exclusion of live stock, the sowing and harrowing in of seeds of native plants, the introduction of new forage plants suited to the arid region, and the construction of small embankments for holding the storm water. As conducted for two years on a reserve of 350 acres they have given promising results. Professor F. Lamson-Scribner, agrostologist of the Department of Agriculture, gave an account of the cooperative work under his direction, which includes arrangements with seventeen experiment stations.

The problems of irrigation in humid regions and the investigations in progress in this line were described and discussed by Professor Elwood Mead, of the Office of Experiment Stations; Professor E. B. Voorhees, director of the New Jersey Experiment Stations; F. H. Newell, of the U. S. Geological Survey and Professor H. J. Waters, director of the Missouri Experiment Station.

Papers on plant breeding were presented by Professor W. J. Stillman, of the Washington Agricultural Experiment Station, and Professor W. M. Hays, of the Minnesota Experiment Station. There was also a paper on the artificial plant food requirements of different soils and the methods employed in fertilizer experiments, by Doctor B. W. Kilgore, director of the North Carolina Experiment Station.

In the report of the section on horticulture and botany the marked strengthening of advanced courses in these subjects in colleges was pointed out. The demand for especially qualified men in horticulture was stated to be greater than the supply. There has recently been rapid progress in bacterial and physiological investigations and special studies on the selection and breeding of plants. At the meeting of the section there was an earnest discussion of the relations of instruction and research in horticulture in the agricultural colleges, called forth by a paper by Professor E. S. Goff, of the University of Wisconsin. The question of cooperation between the farmer and the experiment station, and the best methods of such cooperation, were also much discussed on the basis of the paper by J. Craig, of the New York Cornell Experiment Station. Other papers were also read in this section on observations concerning the first and second generations of plants, by Professor B. D. Halsted, of the New Jersey Agricultural Experiment Stations; on the effect of light and heat on the germination of Kentucky blue grass, and on the quality of some commercial samples of grass and clover seed, by E. Brown of the Bureau of Plant Industry.

Professor L. C. Corbett, of this Bureau, described the experimental farm of the Department of Agriculture which is being established on a part of the Arlington estate near Washington. It is intended to plant on this farm extensive collections of varieties of fruits in order to have authentically named specimens for comparative studies; cultural experiments with fruits and crops, and phenological investigations are also to be undertaken there. Mr. F. D. Gardner, of the Office of Experiment Stations, who is in charge of the newly established experiment station at Porto Rico, made an interesting exhibition of fruits which he had brought from that island; and H. J. Webber, of the Bureau of Plant Industry, exhibited specimens of cowpeas which are believed to be resistant to the attacks of nematodes.

In this connection it may be well to state that a newly organized society of official horticultural inspectors for the United States and Canada held its sessions in Washington, November 11 to 13. Representatives from fifteen States were present.

Professor S. A. Forbes, of the University of Illinois, presided. With regard to the limits of time within which nurseries may be inspected, it was found impossible to determine upon any definite period for all States, since the local conditions, requirements of State law, and other demands of State inspectors rendered uniformity in this matter impossible. In a discussion of the nursery pests which are to be regarded as dangerous enough to influence the granting of a certificate those mentioned by different inspectors as of chief importance included the crown gall, peach yellows, pear blight, San Jose scale, woolly aphis and sinuate pear borer. In a discussion of the question of the best insecticide for orchards infested with San Jose scale, the fact was brought out that the results of experiments with kerosene, crude petroleum and mechanical combinations of both these substances with water were not uniform in different States. Resolutions were passed to the effect that the time of inspection should be left to the discretion of the inspector of each State; that the certificate should not extend beyond the time of the beginning of the breeding period of the San Jose scale for the next year; that one form of certificate should be issued as a rule, which should be so worded that the stock could be sold after objectionable stock had been treated, as suggested by the inspector; and that in States which required inspection of nursery stock the expenses of inspection should be borne by the State.

The report of the section on entomology presented by Professor M. V. Slingerland, of the Cornell University Experiment Station, reviewed the progress of entomology during the past year, especially as regards instruction, investigation and inspection. At the meeting of the section the following papers were read: 'A Year's Experience with Crude Petroleum in New Jersey,' by Professor J. B. Smith, of the New Jersey Experiment Stations; 'Some of the most Important Insects in Massachusetts,' by Professor H. T. Fernald, of the Massachusetts Hatch Experiment Station; 'The Time of Emergence and Oviposition of the Spring Brood of the Hessian Fly,' by H. Garman, of the Kentucky Experiment Station; 'Life History of the Sugar Cane Borer in Louisiana,' by Professor H. A. Morgan, of the Louisiana Experiment Stations; 'Florida Observations and Experimental Work,' by H. A. Gossard, of the Experiment Station of Florida; 'Apple Aphids,' by E. D. Sanderson; 'A Folding Fumigator,' by F. A. Sirrine, of the New York State Experiment Station.

The report of the section on mechanic arts was presented by Professor H. W. Tyler, of the Boston School of Technology. This gave at some length the progress of instruction in mechanic arts during the year.

A reception tendered to the Association by the Secretary of Agriculture and Miss Wilson was numerously attended by the delegates and their ladies, and was thoroughly enjoyed by all who participated in it.

The following officers of the Association for the ensuing year were elected:

President, W. M. Liggett, of the College of Agriculture of the University of Minnesota; Vice-Presidents, W. O. Thompson, of the Ohio State University; H. J. Waters, of the University of Missouri; J. H. Washburn, of the Rhode Island College of Agriculture and Mechanic Arts; J. H. Worst, of the North Dakota Agricultural College; and J. C. Hardy, of the Mississippi Agricultural and Mechanical College; Secretary-Treasurer, E. B. Voorhees, of the New Jersey Experiment Stations; Bibliographer, A. C. True, of the Department of Agriculture; Executive Committee, G. W. Atherton, of the Pennsylvania State College; H. H. Goodell, of the Massachusetts Agricultural College; Alexis Cope, of the Univer-

sity of Ohio, and H. C. White, of the Georgia State College of Agriculture and Mechanic Arts.

Officers of sections: College Work, J. L. Snyder, of the Michigan Agricultural College, chairman; W. E. Stone, of Purdue University, Indiana, secretary; Agriculture and Chemistry, H. J. Waters, of the University of Missouri, chairman; C. G. Hopkins, of the University of Illinois, secretary; Horticulture and Botany, J. Craig, of the New York Cornell University, chairman; A. Nelson, of the University of Wyoming, secretary; Entomology, F. M. Webster, of the Ohio Experiment Station, chairman; H. E. Summers, of Iowa State College, secretary; Mechanic Arts, H. W. Tyler, of Massachusetts Institute of Technology, chairman; F. A. Anderson, of the Kentucky Agricultural and Mechanical College, Secretary.

A. C. TRUE.

MARCEL NENCKI.

BY the death, on October 14, of Professor Marcel Nencki, director of the Laboratory of Physiological Chemistry in the Institute of Experimental Medicine at St. Petersburg, physiological chemistry has lost one of its most active workers. Professor Nencki was born in Poland, January 15, 1847. After completing his medical studies at Berlin, he went to Berne in 1872, as assistant in the Pathological Institute of the Swiss University. At the same time he became Privatdocent in physiological chemistry; and his appointment to a chair in that subject, in 1877, was among the earliest recognitions which the science received as an independent field of study. In 1891 Professor Nencki went to St. Petersburg to take charge of one of the laboratories in the newly founded Institute, being succeeded at Berne by the late Professor Drechsel.

Of Professor Nencki's extensive contributions to organic chemistry, physiological chemistry and bacteriology, it will suffice here to recall his investigations on the chemistry of putrefaction and on the chemical processes which take place in the intestine; his studies on the behavior of aromatic bodies in the animal organism; his thorough researches on the pigments of the blood and on animal pigments in general; the investigation of the formation of ammonia and urea in mammals; and his last published paper (with N. Sieber) on the chemical composition of enzymes. In 1897, on the twenty-fifth anniversary of the beginning of his scientific activity, there appeared a volume entitled 'Sommaire des travaux accomplis par M. le professeur M. Nencki et ses élèves dans ses laboratoires à Berne et à St. Petersbourg.' 1869–1896. In recent years he has collaborated with Professor Andreasch in editing Maly's 'Jahresbericht über die Fortschritte der Thierchemie.' Although interrupted thus early, the work of a lifetime earnestly devoted to the pursuit of scientific truth has left many records of permanent value.

L. B. M.

SCIENTIFIC LITERATURE.

Studien über den Körperbau der Anneliden, V. By EDUARD MEYER. Translated from the original Russian. In Mittheilungen aus der Zoologischen Station zu Neapel, XIV., 3, 4, 1901. Pp. 338, 6 double plates.

Of the many attempts that have been made to explain the historical origin of the mesoblast and cœlome in higher animals, none is of greater interest than that of Professor Eduard Meyer, of the University of Kasan, whose views find their latest and fullest development in the present masterly paper, the product of many years of painstaking research by an uncommonly clear-sighted observer. All students of embryology are familiar with Hatschek's pregnant suggestion, made in 1877, that the mesoblastic pole-cells, characteristic of annelidan and molluscan development, were originally germ-cells, and that the cœlome of the annelids shows essentially the same relations as the gonad-cavities of the platodes. Accepting this sugges-

tion, R. S. Bergh, in 1885, maintained that the segmented cœlome of annelids is homologous with the cavities of the gonad-follicles of platodes and nemertines, and that the primitive function of the peritoneal epithelium of annelids was that of a germinal epithelium. The same conclusion was independently reached by Meyer and developed by him in 1890, as a sequel to his embryological studies on *Psygmobranchus*, into a general theory, of which the essential points are that the mesoblast-bands (developed from the pole-cells) of annelids are homologous, as a whole, with the paired gonads of the platodes; that by a change of function many of the primitive germ-cells gave rise to somatic mesoblastic elements; that by this process a 'secondary mesoblast' arose; and that lastly, by a partial process of substitution, the secondary mesoblast, in a greater or less degree, took the place of the primary mesoblast of the platode, which, however, still appears in the ontogeny as the 'larval mesenchyme' and some other structures. These last assumptions were not mere guesses, but were based on careful observations which showed that in at least one larval annelid (*Psygmobranchus*) there are two entirely distinct sources of mesoblast, namely, a 'primary mesenchyme' derived from the ectoblast, and a 'secondary mesoblast' derived from the pole-cells, and forming the 'mesoblast bands' in the ordinary sense. The former gives rise to the larval muscles, some of which are only temporary or provisional structures (including the protrochal ring-muscle), and to some of the adult muscles, including those of the gut, of the dissepiments, and the circular muscles of the body-wall. The latter gives rise to the peritoneal epithelium, the gonads, and the longitudinal muscles of the adult. These results were supported by the independent observations of Bergh and Vejdovsky, showing that in leeches and earthworms also the circular muscles are of wholly different origin from the longitudinal ones, the latter alone arising from the mesoblast pole-cells.

In the present paper Meyer reenforces his position by a great number of new observations on many different annelids, of which the most thoroughly studied were *Polygordius* and *Lopadorhynchus*. Although both these forms had already become classical objects through the earlier work of Hatschek, Fraipont, Kleinenberg and others, Meyer brings forward an almost bewildering profusion of new results for both, which sustain and extend his earlier conclusions on *Psygmobranchus*. In both forms primary and secondary mesoblasts are wholly distinct in origin and in fate; in both, the mesoblast bands (secondary mesoblast) give rise only to the peritoneal epithelium, the gonads and the definitive longitudinal muscles of the body-wall; in both there are several regions in which mesoblast (primary mesenchyme) is independently derived from the ectoblast. From the primary mesenchyme are derived not only the provisional larval musculature, but also an important part of the definitive musculature, namely, that of the gut, of the parapodia and cephalic appendages, of the dissepiments, and the circular and diagonal muscles (when present) of the body-wall. Meyer thus shows that although a part of the larval musculature (for instance, the prototrochal ring-muscle) is undoubtedly of a provisional character, yet a much larger part of it is retained in the adult than has hitherto been supposed. This part is assumed to have been derived from the platode parenchyma, which has, as it were, been carried over into the annelid organization. Among many interesting special points may be mentioned the discovery of a *paratrochal* ring nerve; and the demonstration, both in *Polygordius* and in *Lopadorhynchus*, of numerous true neuromuscular foundations—*i. e.*, areas in which nerve-cells and primary muscle-cells are proliferated from common ectoblast areas, but it is also shown with perfect clearness that Kleinenberg was in error in maintaining the origin of the secondary mesoblast-bands and the ventral nerve-cords from such a common neuromuscular foundation. Interesting detailed studies are given of the larval nervous system; Kleinenberg is shown to have been in error in deriving the germ-cells directly from the ectoblast; and the existence of Hatschek's famous nephridial 'Längscanäle' is again denied.

Fortified by these new facts, Meyer reasserts and further extends his original hypothesis, giving a thorough and critical review of the

literature and putting forward many ingenious suggestions regarding the possible phylogeny of the cœlome, blood-vessels and musculature, the origin of metamerism, and other deep-lying morphological problems. Phylogenetic speculations on embryological data are getting out of fashion, and some of Meyer's conclusions will doubtless meet with little sympathy on the part of those whose interest in the historical problems of morphology has suffered a temporary attack of paralysis through devotion to more 'modern' questions. Even the sceptical reader, however, who will take the trouble to examine Meyer's work with care, will not be able to deny that the theoretical views are everywhere held closely in touch with admirably thorough and extended observation, and constitute no mere inflated speculative system, but a natural working hypothesis growing directly out of the facts.

In the present paper Meyer considers only the larval development; and his results form a most important supplement to that of students of cell-lineage, who have not, in general, carried their work to a sufficiently late period to determine the real relation of the germ-layers to the adult body. It may be pointed out, however, that the comparative study of cell-lineage in platodes, annelids and mollusks has steadily added weight to Meyer's original contention of a double origin of the 'mesoblast,' for it has shown that in the two higher groups a 'larval mesenchyme' is often formed from cells of the ectoblastic quartets, which are quite distinct from the pole-cells of the secondary mesoblast, the latter (with the apparent exception of *Capitella*) being always derived from a cell of the fourth quartet (otherwise entoblastic). The cell ancestry of the larval mesenchyme thus agrees in a general way, though with interesting modifications of detail, with that of the mesenchyme (mesoblast) of polyclades, which inevitably and independently suggests the same view as that of Meyer, though from a quite different point of view.* Meyer's observations render it in the highest degree probable that, as the writer has suggested, mesenchyme may arise from any of the three ectoblastic quartets; for (not to mention the so-called 'head-kidneys' of *Nereis*), such origin has already been observed in the second and third, and if the cell-lineage of *Polygordius* and *Lopadorhynchus* is of the same type as in other annelids, as can hardly be doubted, the umbrellar neuro-muscular foundations in these forms must be derivatives of the first quartet.

* Cf. Wilson, 'Considerations on Cell-lineage and Ancestral Reminiscence,' in *Annals N. Y. Academy of Sciences*, XI., 1, 1898.

The gonad theory of the cœlome, which Meyer has done so much to advance, has made a deep impression on morphology, as may be seen, for instance, by reference to the admirable review of the theories of the cœlome by Ray Lankester in the second volume of his 'Treatise on Zoology,' which appeared last year; and it has made serious inroads on the widely accepted enterocœle theory. Whether the two views can be reconciled is not to be determined without further research; for some of the most important observations on which Rabl, Lankester and others have relied in attempting to trace the transition from the pole-cell type to the enterocœle type (*e. g.*, pole-cells in *Amphioxus*, gut-pouches in *Paludina*) have been shown to be erroneous. Meyer believes the enterocœle type to be secondary; Lankester accepts the reverse view. Others have suggested the possibility that the two types have been distinct from the beginning, and this has for years been held open in the writer's advanced lectures on zoology and embryology as a possible basis for a division of the 'triblastic' animals into two parallel but independent series that diverged further down than the platodes—a division which, though entirely provisional, and as yet without adequate basis, nevertheless brings into order a surprisingly large number of facts otherwise difficult to reconcile. This is a question for the future, and may be left with Lankester's significant remark, that "When the cell-lineage of mesenchyme and its tissue-products has been cleared up we may be able finally to put aside the hasty criticisms and phantastic assertions of those who have grown impatient over the slow and difficult task of cellular embryology." EDMUND B. WILSON.

Publications of the University of Pennsylvania, Astronomical Series. Volume I., Part III.

The work before us is Part III., of the publi-

cations begun by the University of Pennsylvania for the new Flower Observatory, which was formally inaugurated with a public address by Professor Simon Newcomb in November, 1897. The Flower Observatory is widely known among astronomers as a new institution managed on a solid conservative basis, by a gifted and devoted staff of untiring workers. Though it has been in operation but a few years, it has already taken its place among the leading observatories of the country. It is distinguished by the care and accuracy of all its work rather than by the quantity of material turned out; and for that reason it has from the start taken rank with the best of modern observatories. The care and painstaking accuracy which characterized Professor C. L. Doolittle's work at the Sayre Observatory in Bethlehem, Pa., was at once recognizable in the spirit of the new institution under his direction at Philadelphia; and the results are now becoming apparent in the first volume of the 'Publications.'

Part II. of this volume appeared more than a year ago, and dealt in a characteristically thorough manner with the variations of latitude observed at Philadelphia, and with several determinations of the constant of aberration incidentally made in connection with the latitude work. This constant came out somewhat larger than the value which had generally been used by astronomers. The value found by Struve and Peters at Poulkowa was 20″.44, and for many years this was accepted as standard; but recent investigations by several authorities tend to increase the figure to about 20″.55, which is the value found by Professor Asaph Hall, Jr., at the Detroit Observatory of the University of Michigan. Professor C. L. Doolittle's several determinations confirm this larger value; and on account of the care and precautions exercised in the work, there is little doubt in the minds of conservative astronomers that this new figure is much nearer the truth than that adopted in the nautical almanacs.

Part III. of Volume I. of the New Publications is devoted to the measures of 900 double and multiple stars made with the 18-inch Brashear refractor of the Flower Observatory, by Professor Eric Doolittle, son of the director of the Observatory. This part consists of 146 large quarto pages of closely set matter, all beautifully and conveniently arranged. There is no defect in the conception or execution of the work, and it is not too much to say that this publication may be taken as a model for astronomers generally.

A concise introduction of eight pages deals with the constants of the equatorial, and with the micrometer employed in the measures. The latter is an ordinary filar micrometer, with the Burnham illumination. Its simplicity enabled the observer to center his whole attention on the work, and the result is a handsome volume of measures on 900 double and multiple stars, all made within the past four years. The stars are chosen mostly from the lists of Burnham, with occasional selections from the Struves and Dewbowski, and such modern observers as Hough and See. They represent in all cases objects requiring measurements. Though no special search was made for new double stars, a list of 22 such objects found in the prosecution of the regular work is given on page 8; all of them being close or interesting pairs which should receive the attention of future observers. The 900 stars measured are arranged in order of right ascension, with places referred to the epoch 1880.0. Their magnitudes and the several designations used by astronomers are clearly and accurately given in each case. The measures are nicely reduced and annual means are formed, according to the classic models of the Struves, Dewbowski and Burnham. The notes accompanying the measures are brief and to the point; no important matter is overlooked, and yet nothing superfluous is ever added. The total number of complete observations is about 3,700, representing something like 44,000 settings of the micrometer.

It should be pointed out that all these observations were taken and reduced by Professor Eric Doolittle alone, in addition to his teaching duties at the University, where he conducts advanced courses of instruction in celestial mechanics. In conclusion it may be noticed that publications dealing with the measurement of double stars are not merely of contemporary interest, but increase in value with time. Thus the work of the Herschels, the Struves and

Dewbowski are immensely more valuable now than when they were made many years ago, by reason of changes in the sidereal heavens which have since intervened; and all precise work such as that now being done at the Flower Observatory is assured of a lasting and honorable place in the history of science. Scientific research prosecuted for its own sake is among the most noble of intellectual pursuits, and the University of Pennsylvania is much to be congratulated on the distinguished place it is acquiring in the astronomical world.

T. J. J. SEE.

WASHINGTON, D. C.

A History of the Precious Metals from the Earliest Times to the Present Day. By ALEX. DEL MAR. Second edition, revised. New York, Cambridge Encyclopedia Co. 1902. 8vo. Illustrated. Pp. xxii + 480, 1–9.

The first edition of this remarkable work was published at London in 1880 and has long since been exhausted; meanwhile the author, in his profession of mining engineer, has visited many remote sources of the precious metals and has secured at first hand new material which has caused the volume to be entirely rewritten. This history is prepared by a profound student, from the point of view of the antiquarian, the archeologist and of the metallurgist, as well as the political economist, and deals with the exploration of the entire surface of the globe for gold and silver from the earliest record of mankind to the present day; copper, tin and the other heavy metals are only incidentally treated. The author is particularly well qualified for this vast undertaking, having already published several serious studies on money, its history, its science and its bearing on the progress of civilization, and having held positions of authority under the United States government, Director of the United States Bureau of Statistics, Mining Commissioner, and member of the International Congresses which met at Turin and at St. Petersburg. He is now engaged on 'The Romance of the Precious Metals' and 'The Politics of Money,' both of which are well advanced.

Mr. Del Mar maintains that the principal motive which has led to the dominion of the earth by civilized races is the desire for the precious metals, rather than geographical research or military conquest; that the occurrence of gold has invited commerce, and the latter has been followed by invasion and eventually permanent occupation. With these facts in mind he portrays the stupendous power exerted by the quest for the precious metals from the beginnings of history in India, Persia, Egypt, Greece, Italy, Spain and the Western Hemisphere. He depicts very vividly the painful ways in which each gold-producing country has been mercilessly plundered by more powerful neighbors, saying that 'mining is slow work compared with plundering.' He also shows elsewhere that mining is generally more expensive than plundering, except where forced labor and slavery is employed. And to illustrate the latter point he claims that 'since the discovery of America the European world has acquired 19,500 and odd millions of dollars, of which 1,000 millions were obtained by conquest, 9,500 millions by slavery and 9,000 millions chiefly by free mining labor.'

Recognizing these sources of the precious metals he is decidedly opposed to the dictum of certain philosophers that the value of gold is its 'cost of production,' and says this formula does not take into account the 'millions of human lives, the rivers of human tears, the oceans of human blood, the immeasurable amount of human anguish.'

This aspect of the case is set forth in powerfully written chapters on the plunder of America (by the Spaniards), of Africa (from the Roman Emperors to South African War), of Asia (by the Romans, Portuguese and the British), and of China in all ages; chapters showing great historical research and learning. The author's arraignment of Spain is particularly interesting at this epoch: "Besides despoiling aboriginal America of her gold and silver, Spain accomplished nothing in the New World except extermination and destruction. She swept away half as many human lives as all Europe contained at the period of the discovery of America. She destroyed every memorial of the Aztec and Peruvian civilizations. She disfigured the entire face of Central and South America. And she planted nothing

in the place of what she destroyed save a race laden with disadvantages and a few mission churches crumbling to decay. The spoil she obtained amounted altogether to some seven thousand millions of dollars." And all this cost the conquerors practically nothing in comparison. And here again the author remarks, "the value of these precious metals is *not* due to the cost of production, but to their usefulness and their quality, to the relation of supply to demand."

It is gratifying to note that Christian civilization now adopts different methods and "the acquisition of the precious metals by means of conquest is virtually over."

The volume is so crowded with facts, as well as with the results of thought and argument, that no ordinary book review can do the author justice; in the words of those who reviewed the first (incomplete) edition, it 'abounds with vivid description and practical knowledge; it is replete with information, and evinces much care and study; it is able and exhaustive; of the highest scientific value, yet readable as a novel.'

In the chapter on 'Production, Consumption and Stocks of Metal' the author does not conceal his poor opinion of the 'defective and misleading statistics of the Mint Bureau,' supported in its methods by Congress, and reflecting 'the narrow views of the Mint Director.' Valuable features are the chronological summaries, the bibliography (with press marks of the British Museum Library) and the index. The volume is clearly printed on good paper, probably in England, as we observe the words 'honour,' 'labour' and 'negros,' instead of the more familiar 'negroes.' There are two illustrations, a mining scene in California and a portrait of General Nelson A. Miles, who is casually mentioned in the text.

The volume is of the highest value.

HENRY CARRINGTON BOLTON.

SOCIETIES AND ACADEMIES.

CALENDAR.

The American Association for the Advancement of Science. A meeting of the council will be held at the Quadrangle Club, University of Chicago, on the afternoon of January 1. Section H (Anthropology) will meet at the Field Columbian Museum, Chicago, on December 31 and January 1. The next regular meeting of the Association will be held at Pittsburgh, Pa., from June 28 to July 3. A winter meeting is planned to be held at Washington, during the convocation week of 1902–3.

The American Society of Naturalists will hold its annual meeting at the University of Chicago on December 31 and January 1. In conjunction with it will meet the Naturalists of the Central States and several affiliated societies, including The American Morphological Society, The American Physiological Society, December 30 and 31, The American Psychological Association and the Western Philosophical Association, December 31 and January 1 and 2.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 538th meeting was held October 12, 1901.

An obituary notice of Mr. C. A. Schott, for many years chief of the computing division of the Coast and Geodetic Survey, was read by Superintendent O. H. Tittmann; and Mr. R. A. Fessenden presented, through Mr. Winston, a paper on 'Progress in Practical and Theoretical Electricity' giving a rapid sketch of the condition of all the great branches of electricity.

The 539th meeting was held October 26, 1901.

Mr. Marcus Baker described 'A Dictionary of Alaskan Names,' now in press, to be published by the U. S. Geological Survey, pointing out its characteristics and the principles on which it is made. It will contain about 6,500 adopted names, 3,000 obsolete names and cross-references and 60 pages devoted to a catalogue of authorities with brief accounts of the explorers. Dr. Dall spoke appreciatively of the work.

Mr. C. H. Hinton, of the Nautical Almanac Office, then read by invitation a paper on 'A Fourth Dimension in Space demanded by Electrical Phenomena.' The paper cannot be summarized, but may be characterized as an attempt to apply to 4-space some principles of quaternions developed for 3-space.

The 540th regular meeting was held November 9, 1901, Vice-President Adler in the chair.

Mr. Hinton continued the presentation of his

views begun at the last meeting on an explanation of electrical phenomena by a fourth dimension in space.

Dr. G. M. Sternberg, Surgeon-general of the Army, reported on 'Health Conditions in the Philippines.' He finds that the health of the troops has been constantly improving; smallpox is practically stamped out; typhoid and malarial fevers and heat strokes are almost unknown. Dysentery is one of the most serious troubles; so at most barracks distilled or sterilized water is supplied. In the discussion that followed Dr. Dall called attention to the absence of malaria in Alaska, although mosquitoes of several species are very abundant.

Dr. Adler reported on the progress of the 'International Catalogue of Scientific Literature.' After conferences for several years, definite plans were settled on during the past summer. Owing to the failure of Congress to take action, the United States was not officially represented, but Mr. Herbert Putnam, Librarian of Congress, was in London and had some share in the negotiations. The plan adopted requires each country to index and classify the literature published within its borders pertaining to 17 branches of science, beginning with 1901; the Smithsonian Institution has temporarily undertaken this work for the United States. The material is then to be arranged and published by the Royal Society in 17 volumes annually; these will be sold separately. About 320 sets have been subscribed for, for 5 years, at £1 per volume; 65 sets are to come to the United States. The speaker described some of the difficulties met with in formulating the plans, gave various details regarding the work, and exhibited the schemes of minute classification to be followed by the indexers.

CHARLES K. WEAD,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 343d meeting was held on Saturday evening, November 16.

C. P. Hartley exhibited some malformed ears of corn, stating that their interest lay in the fact that they had been grown from seed taken from an ear similarly abnormal, the malformation having been reproduced.

H. E. Van Deman showed a specimen of the ripe fruit of the guava from Florida, and made some remarks on the extent to which this fruit was now being cultivated.

L. O. Howard announced that he had received a letter from Mr. C. L. Marlatt, announcing the discovery of the long-sought original habitat of the San José scale insect; this was found to be in China, in the region to the south of the Great Wall. The scale insect was preyed upon by a species of ladybird beetle, living examples of which were now on their way to the United States.

H. G. Dyar presented some 'Notes on Mosquito Larvæ,' being a summary of investigations made during the past summer and including the following species: *Anopheles crucians*, *punctipennis*, *maculipennis*; *Culex solicitans*, *territans*, *pungens*, *confinis*, *canadensis*, *sylvestris*; *Stegomyia fasciata*; *Ædes smithii*; *Uranotænia sapphirina*; and *Psorophora ciliata*. The habits and habitats of these various larvæ were described, and it was pointed out that there was great diversity in the latter. Some species preferred clear water, others infested turbid pools, and still others were found in brackish water. The speaker showed drawings of the different larvæ and drew attention to their peculiarities and their distinctive specific characters. It was noted that a species of fresh-water hydroid was seen to feed on mosquito larvæ, while on the other hand one species of larvæ fed on bacteria and another fed on other larvæ.

C. B. Simpson gave some 'Observations on Jack Rabbits,' telling of their rapid increase in parts of the west and describing their runways among the sage brush and the manner in which they were hunted by their great enemies the coyotes.

Vernon Bailey described 'The Little Deer of the Chisos Mountains, Texas,' stating that the same species, *Odocoileus couesi*, was also found in Mexico, Arizona and New Mexico, so that their occurrence in this locality was an extension of their known range. Owing to the distance of the Chisos Mountains from the railroad and the unfitness of the country for grazing purposes, the deer were still to be found there in considerable numbers. The speaker said that an adult buck would weigh only one hun-

dred pounds, and a doe much less, and pointed out the differences between the color of the summer coats of this and the large white-tailed deer of Texas, *Odocoileus texensis.*

Barton W. Evermann spoke of 'Birds in the Dry Season,' stating that few realized how important to birds was a supply of water, nor the influence of drouth on the distribution of birds. During an unusually dry summer the California quails did not breed, but kept together in flocks as they did during the fall. The speaker gave a list of eighteen species of birds that were seen to resort to a single leaking water spigot and described the manner in which various species drank. In conclusion it was suggested that during dry seasons, or in arid regions, drinking places should be provided for the benefit of the birds.

F. A. Lucas.

DISCUSSION AND CORRESPONDENCE.

METEOROLOGICAL OBSERVATIONS WITH KITES AT SEA.

To the Editor of Science: On page 412 of Science I stated that meteorological observations were about to be attempted with kites flown from a transatlantic steamer. With the aid of my assistant, Mr. Sweetland, and through the courtesy of Captain McAuley, this was accomplished on board the Dominion steamship *Commonwealth*, which left Boston for Liverpool on August 28. During most of the voyage we were within an area of high barometric pressure that was drifting slowly southeastward and out of which light winds blew. Although these were insufficient to raise the kites, the ship's speed of 16 knots created a corresponding wind from an easterly direction that sufficed to lift the kites on five of the eight days occupied by the voyage to Queenstown. On one of the three unfavorable days, a following wind became too light on the ship for kite-flying, and on the two other days a fresh head wind, augmented by the forward motion of the ship, was so strong as to endanger the kites, but, had it been possible to alter the course of the vessel, a favorable resultant wind might have been produced every day. The maximum height attained was only about 2,000 feet, but with larger kites and longer wire this could have been greatly exceeded. Automatic records were obtained of barometric pressure, air temperature, relative humidity and wind velocity, which did not differ markedly from records obtained in somewhat analogous weather conditions over the land. The most striking feature was the rapid decrease of the temperature with increasing height in all but one of the flights. The fall of temperature was fastest in the first 300 feet, where it exceeded the adiabatic rate of 1° Fahrenheit in 183 feet, but in the last-mentioned flight the temperature rose 6° in 660 feet, and during the afternoon remained so much warmer than at sea-level. The relative humidity varied inversely with the temperature, the direction of the wind shifted aloft toward the right hand when facing it, and its velocity generally diminished with altitude. These are probably the first meteorological observations at a considerable height in mid-Atlantic, and have a special importance because they indicate that at sea high-level observations may be obtained with kites in all weather conditions, only excepting severe gales, provided the steamer from which the kites are flown can be so manœuvered as to bring the wind to a suitable velocity.

As the basis of an appeal for the exploration of the atmosphere at sea, the records described were exhibited to the Geographical Section of the British Association at its Glasgow meeting, and the appointment of a committee, with a grant of money to undertake observations with kites in Great Britain, together with the interest manifested there and on the continent of Europe, encourages the hope that my project will be realized. The equipping of the English Antarctic vessel *Discovery* with meteorological kites, as mentioned on page 779 of Science, and a similar installation on the German Antarctic ship *Gauss*, are unlikely, for various reasons, to have yielded much data on their voyages across the equator. Although the United States has taken no part in this international undertaking, an opportunity is now offered, without material expense, danger or hardship, to cooperate in a study of the general atmospheric circulation, which is one of the objects of polar exploration. Indeed, for a naval vessel not actually engaged otherwise, the sounding of the atmosphere in the tropics, whereby the relation of the upper air

currents to the winds useful for navigation may be ascertained, would seem to be as legitimate a task as sounding the depths of the oceans and determining the currents and temperatures prevailing there. But if our Navy Department will not authorize this, a private expedition should be organized to investigate the questions mentioned in my letter to SCIENCE on 'A New Field for Kites in Meteorology.' Since then, Professor Hildebrandson, of Upsala, who is an eminent authority on the circulation of the atmosphere, writes me that a meteorologist on a steamship provided with kites, and also with small balloons to ascertain the drift of the upper winds when there are no clouds, by making atmospheric soundings between the area of high barometric pressure in the North Atlantic and the constant southeast trades south of the equator, and in this way investigating the temperature and flow of the so-called anti-trades, could solve in three months one of the most important problems in meteorology. If any of your readers will furnish the steamer required, I stand ready to carry out these investigations.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY, HYDE PARK, MASS.,
November 18, 1901.

PERMANENT SKIN DECORATION.

IF Mr. H. Newell Wardle* had referred to Mr. H. Ling Roth's great compilation, 'The Natives of Sarawak and British North Borneo,' he would have found the Bornean process of tatooing described and the implements figured. From actual experience I can assure Mr. Wardle that in Sarawak, at all events, the pattern is gently printed on the skin from a wooden block and the pigment is driven into the skin by means of an ordinary tatooing needle which is hit by a slender iron rod. This is the typical Tahitian 'tatu.' Examples of the apparatus employed will be found in the splendid Furness-Hose collection in the Free Museum of Science and Art in Philadelphia.

A. C. HADDON.

* SCIENCE, Vol. XIV., p. 776.

LIFTING HOT STONES.

TO THE EDITOR OF SCIENCE: In the late number of *Nature* Professor S. P. Langley calls attention to an old Tahitian priest who walked in bare feet over the heated stones of a pit prepared for cooking. Mr. Andrew Lang calls attention also to the fact that this was a ceremonial performance, preparatory to the cooking.

The United States National Museum is in receipt of a letter from Lieutenant Campbell E. Babcock, U. S. A., stationed at Vancouver Barracks, Washington State, enclosing a communication from Chief Peter Wildsho, of the Cœur d'Alene Indians in Idaho. Peter in his simple way is telling how fifty years ago his ancestors cooked their food in basket pots by means of hot stones. At the close of the description is the following in Peter's own words: "An amazing little story is connected with this basket for cooking food with hot stones. The medicine-man was considered a very powerful being by his tribe. He could take away the life of a man at his word or cure a sick or dying person. His power depended on the wild beasts that are fierce and powerful, and he carried constantly around his body some parts of the animal, such as a piece of the tail." This man to show his power stripped himself and painted his body. While he was singing and dancing, accompanied by all the Indians, he went to the basket containing cold water and sang, and, while all were watching him in awe, he slowly took the red-hot stones in both hands and dropped them into the basket of cold water. The water was heated and not a blister or burn was to be seen on his hands.

O. T. MASON.

THE HITTORF JUBILEE.

THE Academy of Sciences at Berlin has issued the following terse summary of the life-work of the venerable Hittorf:

HERRN JOHANN FRIEDRICH HITTORF zum Fünfzigjährigen Doctorjubilaeum am XXI. October MDCCCLXXXXVI.*

HOCHGEEHRTER HERR COLLEGE!

Indem die Königliche Akademie der Wissenschaften Ihnen zu der Jubelfeier Ihrer Promotion herzliche Glückwünsche sendet, erinnert sie sich dankbar des hervorragenden Antheils Ihrer Arbeit an dem Fortschreiten Ihrer Wissenschaften, der Physik und der

* Usually known as Wilhelm Hittorf.

physikalischen Chemie, in den verflossenen fünfzig Jahren.

In Ihrer scharfsinnigen Untersuchung des Selens und des Phosphors wiesen Sie den Zusammenhang der Allotropie mit der von dem Körper aufgenommemen Wärmemenge nach. Sie stellten die physikalischen Eigenschaften der Substanz in den verschiedenen Zuständen, insbesondere bezüglich der Dampfspannung fest und fanden merkwürdige Beziehungen der Allotropie zu dem elektrischen Leitvermögen.

Die Hauptarbeit Ihrer früheren Forschung aber war auf die Elektrolyse der Lösungen gerichtet. Es ist schwer zu sagen, ob die Bewunderung, zu welcher diese Arbeiten zwingen, mehr der Exactheit und Ausdauer bei der Bestimmung der Ionenwanderung entspringt, einer der mühsamsten, jemals angestellten experimentellen Forschungen, deren Resultate durch spätere Arbeiten nur bestätigt und kaum erweitert worden sind, oder aber der Folgerichtigkeit und Stetigkeit Ihrer Anschauungen über die elektrolytischen Vorgänge. Durch Sie allein sind wir an die richtigen Vorstellungen gewöhnt worden, welchen Sie gegen den Widerspruch selbst hervorragender Physiker Geltung verschaffen mussten, und von denen Sie später die Freude erlebt haben, dass sie das Fundament für einen grossen Theil der neueren physikalischen Chemie geworden sind.

Von ähnlicher grundlegender Bedeutung war die andere grosse Arbeit Ihres Lebens, die Erforschung der Vorgänge bei der elektrischen Entladung in Gasen. Schon in der ersten Entwickelungszeit der Spectralanalyse hatten Sie sich mit PLÜCKER an der verdienstvollen Classification der Spectra betheiligt. Ihre späteren grossen Arbeiten umfassten die Gasentladung in der Hauptsache nach allen Seiten ihrer Gesetze.

Sie waren der Erste, welcher einen der merkwürdigsten Vorgänge in der Natur dessen Fruchtbarkeit für die Wissenschaft und in der letzten Zeit auch für das Leben noch nicht bis zum Ende abgesehen werden kann, die Kathoden-Entladung im luftverdünnten Raume, in seiner vollen Entwickelung zur Anschauung brachte. Sie zuerst stellten das Vacuum in der hierzu nothwendigen und später nicht übertroffenen Vollkommenheit her und beobachteten und beschrieben die Ausbreitung und die vielseitigen Wirkungen der Kathodenstrahlen in musterhafter Weise. Zugleich gelang es Ihnen, diese Vorgänge der elektrischen Messung zugänglich zu machen und nach der Seite der Stromvertheilung wie des Leitungswiderstandes zu verfolgen. Dabei ergab sich, dass die Elektricitätsleitung der Gase ganz anderen Gesetzen folgt, als diejenige in Metallen oder Elektrolyten. Grosse Dienste leisteten bei dieser Forschung Ihre, für die damalige Zeit im grössten Stile ausgeführten Stromerzeuger, mittels deren Sie die intermittirende Entladung durch eine solche ersetzten, deren continuirliche Beschaffenheit, entgegen der verbreiteten Meinung, durch sinnreiche Hülfsmittel von Ihnen nachgewiesen wurde. Auch an den neueren Aufschlüssen über die Natur des Leuchtens im allgemeinen haben Sie bei diesen Gelegenheiten einen verdienstvollen Antheil genommen.

Ihre Arbeit, hochgeehrter Herr College, bildet ein classisches Beispiel für die Erfolge, welche durch die Concentration der Forschung erreichbar sind. Die Wissenschaft wird Ihnen für alle Zeiten zu tiefem Dank verpflichtet sein.

DIE KÖNIGLICH PREUSSISCHE
AKADEMIE DER WISSENSCHAFTEN.

The committee having the matter in charge purpose additionally to celebrate the fiftieth anniversary of Hittorf's doctorate by presenting him with a bust or a similar testimonial of their appreciation.

CARL BARUS.

SHORTER ARTICLES.

FUSARIUM EQUINUM (NOV. SPEC.).

AN epidemic skin disease among horses has appeared on the Umatilla Indian Reservation, Pendleton, Oregon. There are upwards of six thousand horses on the reservation, and of these more than sixty per cent. are said to be affected. The disease manifests itself through severe itching and loss of hair over almost the entire body. The animals remain around the rubbing posts all day, and a number of them die from starvation.

An examination of samples of the skin forwarded to the Pathological Division of the Bureau of Animal Industry demonstrated the presence of *Sarcoptes equi*. These parasites, however, were not present in sufficient numbers to account for the almost complete alopecia, and a careful examination of some samples, almost denuded of hair, failed to show their presence.

Microscopic examination of sections of the skin, stained with borax blue, or after Gram, showed the presence of large half-moon, spindle- or sickle-shaped bodies, deeply stained, in the hair sacs and sebaceous glands.

By pulling out one or more of the remaining hairs, clipping off the root with sterile scissors,

and shaking these roots up in melted agar and plating there develops, at 37° C., in the course of a few days, from one to five circular colonies of a fungus which grows rapidly and assumes a salmon-pink color. Cover-glass preparations made from these colonies contain numerous sickle-shaped segmented spores, characteristic of *Fusarium*.

There are, according to Dr. Erwin F. Smith, about twenty-five known varieties of this fungus. Some are strict saprophytes, others are parasitic on grains and plants, and others are pathogenic to plants. No *Fusarium* has, however, been known to be pathogenic to animals. I would, therefore, pending the present investigation, which will require some time, propose the name *Fusarium equinum* nov. spec.

VICTOR A. NÖVGAARD.

WASHINGTON, D. C.,
Nov. 14, 1901.

RHIZOCTONIA AND THE POTATO.

ATTENTION has been called recently to the parasitic nature of *Rhizoctonia* on various plants in the United States by Dr. B. M. Duggar and Professor F. C. Stewart. Observations at the Colorado Experiment Station on the relation of this fungus to the potato have brought out some interesting facts. During the spring months sclerotia develop freely on tubers and young sprouts in sacks and bins. A few affected tubers in a sack or bin of clean tubers, under favorable conditions, will spread the disease and in a short time render the entire lot worthless for seed. Affected tubers used for seed transmit the disease to the young plants, and these in turn to the following crop of tubers. Under proper conditions the fungus attacks all parts of the potato plant and in all stages of growth, but it is most destructive to the softer tissues. The weaker plants are often killed before they reach the surface of the ground. Those which are able to withstand its earlier attacks are apt to suffer more or less injury from it later in the season.

Little potatoes are produced by the fungus injuring the tuber stems in such a manner as to prevent free transportation of plant food between the main stem and tubers, or by completely cutting off the tuber stem while the tubers are small. When the tuber stem receives an injury sufficient to check the free transportation of plant food, the food accumulates above the injury and soon excites the buds on the tuber stem above this point into growth. These buds develop into tubers. The fungus may continue its work and in time kill back the tuber stem, or it may cut off this stem above the newly formed tubers. If the tuber stem is attacked just as it grows out of the main stem adventitious buds may push out on the main stem around the injured point. These usually develop into short-stemmed or stemless tubers, forming bunches of small tubers. If the roots are badly injured the food supply is reduced and the plant puts out weak tuber stems. These stems are easily cut off by the fungus and the plant usually sets few or no tubers. The food which it is able to take up is used mostly in top development. The leaves become thicker, have a tendency to crinkle and take on a yellowish tinge. When the roots are less severely injured but the free transportation of food to the subterranean stems is interfered with, excessive top development is produced, and the axillary buds may develop aerial potatoes.

Aerial potatoes may be produced artificially: (1) By ringing the stem; (2) by tying a line firmly around the growing stem; and (3) by removing the subterranean tubers as soon as formed.

Sclerotia are often found on the surface of the larger tubers. Apparently these sclerotia do no injury, but experiments show conclusively that scabbing and browning of tubers may be produced by this fungus.

The corrosive sublimate treatment is promising as a preventive of this disease.

F. M. ROLFS.

FORT COLLINS, COLO., Nov. 11, '01.

THE WORK OF THE 'ALBATROSS.'

STUDENTS of marine zoology will welcome the appearance of the brochure just issued by the U. S. Fish Commission, compiled by C. H. Townsend, and entitled, 'Dredging and Other Records of the Steamer *Albatross*, with Bibliography Relative to the Work of the Vessel.' This useful paper contains in condensed form

the records of the work of the *Albatross* for eighteen years, for this vessel has never been out of commission since she was turned over to the Fish Commission, all necessary repairs having been made during intervals between the various cruises. The Bering Sea controversy and the war with Spain interrupted the regular work of the vessel for several years, but with these exceptions she has been almost continuously engaged in investigating fisheries and fishing grounds, in deep-sea sounding and dredging, and in other branches of hydrographic work.

The dredging and trawling records run from 1883 to 1900 and include data of 1,786 hauls of the dredge and trawl, from depths of less than 100 fathoms down to the maximum of 4,173 fathoms, the deepest water in which a dredge has been used. Three charts, bearing the serial numbers of stations, show the extensive area covered by these operations.

The record of hydrographic soundings shows the date, latitude and longitude, depth and character of bottom, in 4,032 soundings, but as the figures have been used in various charts no map of these is given.

Then follow records of the surface and intermediate tow nets, miscellaneous records and records of serial temperatures. All these will not only aid in identifying the large collections placed in the hands of specialists or deposited in museums, but make intelligible many references contained in papers on the *Albatross* collections in which localities are referred to by the station number only.

The chronological bibliography relative to the work of the *Albatross* between 1884 and 1901 comprises 233 titles, and a list is appended of 63 papers now in course of preparation. Finally we are given a list of something like 2,000 new species, largely of deep-sea fishes and crustaceans, which have been described from specimens obtained by the *Albatross* and which give some idea of the amount of material secured. Those who are familiar with the magnificent volumes of the *Challenger* report may be surprised to learn that the zoological material on which they are based is in every way much less than that procured by the *Albatross*, but the *Challenger* material has had the advantage of being systematically worked up and published in consecutive volumes, and in a manner to show it to the best advantage. The *Albatross* has probably obtained a hundred deep-sea fishes where the *Challenger* obtained one, a statement that may be illustrated by saying that a single haul of her trawl brought up many more specimens of *Macrurus* than were secured by the *Challenger* in her entire cruise. In a way this wealth of material has been truly an embarrassment of riches, for its accumulation, and particularly its care, have occupied the time of those who might otherwise have been engaged in its study ; nevertheless, we can but hope that the scientific work of the *Albatross* may proceed in the future as it has in the past.

F. A. L.

RICHMOND MAYO-SMITH.

THE Council of Columbia University adopted the following resolution on the death of Professor Mayo-Smith :

The members of the University Council have learned with profound regret and unfeigned sorrow of the sudden death of their long-time friend and colleague, Professor Richmond Mayo-Smith, the chief of the Department of Political Economy in this University.

During his zealous, devoted and successful service of twenty-four years in this institution, he founded the department over which he has presided and developed it to so high a point of excellence that it has few equals in this country or in the world. He was, moreover, the chief promoter, if not the founder, of the science of statistics in this country. His published works upon this most difficult subject have brought exact and orderly knowledge into a domain where, before, uncertainty and confusion prevailed, and have earned for him honor and gratitude from the scientific world.

His activity went, however, beyond the limits of his own department. As a member of the University Council from the date of its establishment to the moment of his death, and of several of its most important committees, he contributed largely and ably to the formation of the policies of the University as a whole, and to the present organization of this complex institution.

To all this must be added the influence of his personality. His thorough scholarship and his great modesty, his unwavering truthfulness and sound judgment, with his genuine deference for the opinions of others, his dignity of character and kindness of heart, and his manliness united with his gentleness, all conspired to make him a great intellectual and moral force, a noble example of high thinking and of simple life, throughout all branches of the University and wherever he was known.

Speaking for themselves and for the bodies which they represent, the members of the Council desire to enter on the records of the Council this minute, expressing their appreciation of the great merit of their colleague and their sense of the great loss which they individually, and the University as a whole, have sustained in the death of Professor Richmond Mayo Smith.

SCIENTIFIC NOTES AND NEWS.

SECTION H (Anthropology) of the American Association for the Advancement of Science will hold its winter meeting at the Field Columbian Museum, Chicago, on Tuesday and Wednesday, December 31 and January 1, 1901–2. Members of the section who wish to present papers will please inform the Secretary, Mr. George Grant MacCurdy, Yale University, New Haven, Conn. Hotel del Prado, Midway Plaisance, will be the headquarters of the Section.

THE completion of fifty years since M. Berthelot began the teaching of chemistry at the Collège de France was celebrated on November 24. Addresses were made by scientific and public men, and a gold medallion was presented by President Loubet.

ARRANGEMENTS have been made to present the eminent French surgeon, M. Odilon-Marc Lannelongue, with a gold medal in celebration of his scientific jubilee.

THE Royal Society's medals will this year be awarded as follows: The Copley Medal to Professor J. Willard Gibbs, Yale University, For. Mem. R.S., for his contributions to mathematical physics; a Royal Medal to Professor William Edward Ayrton, F.R.S., for his contributions to electrical science; a Royal Medal to Dr. William Thomas Blanford, F.R.S., for his work in connection with the geographical distribution of animals; the Davy Medal to Professor George Downing Liveing, F.R.S., for his contributions to spectroscopy; and the Sylvester Medal to Professor Henri Poincaré, For. Mem. R.S., for his contributions to mathematical science.

IN celebration of the hundred and fifteenth anniversary of its foundation, the Göttingen Academy of Sciences has made the following elections: Honorary members: Professors Abbe (Jena) and Neumayer (Hamburg); non resident members: W. Waldeyer (Berlin), Gaston Darboux (Paris), W. Zittel (Munich) and J. Wislicenus (Leipzig); corresponding members: Aurelius Voss (Würzburg), Hugo Seeliger (Munich), Max Planck (Berlin), Karl Runge (Hanover), Arthur Schuster (Manchester), Swante Arrhenius (Stockholm), Giovanni Ciamician (Bologna), Emil Fischer (Berlin), Wilhelm Ostwald (Leipzig), Walther Spring (Liège), Hermann Minkowski (Zurich), Charles Barrois (Lille), Lazarus Fletcher (London), Michel Levy (Paris), Victor Uhlig (Vienna), Friedrich v. Recklinghausen (Strassburg), Karl Chun (Leipzig), Giov. Batt. Grassi (Rome), Herbert Ludwig (Bonn), Edmond Perrier (Paris).

DR. SMITH ELY JELLIFFE has been appointed visiting neurologist to the New York Hospital, the position having been made vacant by the resignation of Dr. Frederick Peterson, recently appointed Commissioner in Lunacy.

DR. TARLETON H. BEAN has been recommended by the Fish and Fisheries Committee of the St. Louis Exposition as chief of that department.

THE lectureship in connection with the California Philosophical Union for the current year has been offered to, and accepted by, Professor R. M. Wenley, of the University of Michigan.

DR. CHARLES HERTY, adjunct professor in chemistry at the University of Georgia, has resigned in order to accept a position in the United States Department of Agriculture.

DR. NICHOLAS SENN, professor of surgery in the Rush Medical College of the University of Chicago, has returned home from a tour of the world, which included a trip across Siberia, *via* the new Russian railroad.

Mr. Joseph W. T. Duvel, who is holding for the third time the Ferry Fellowship in botany at the University of Michigan, spent the summer and fall in Europe, inspecting the several botanical experiment stations. He is again carrying on research work on the conditions affecting the germination of seeds, in the botanical laboratory of the University of Michigan.

Dr. William R. Harper, president of the University of Chicago, has accepted the directorship of the educational congresses to be held in connection with the World's Fair in St. Louis.

Mr. John Hyde has resigned the editorship-in-chief of the *National Geographic Magazine*, which he has held since 1895, with a view to devoting so much of his time as is not occupied with his exacting duties as statistician of the U. S. Department of Agriculture to work in a much-neglected branch of economic science.

Dr. Remlinger, director of the Antirabic Institute at Constantinople, has been appointed chief of the Imperial Bacteriological Institute, replacing Professor Nicolle. Dr. Remlinger will continue also to hold his former post.

Mr. Alfred L. Jones, the originator of the School of Tropical Medicine at Liverpool, has been made a Knight Commander of the Order of St. Michael and St. George.

Mr. William Marconi left London on November 25, for Newfoundland, where he will select sites for the erection of stations for his system of wireless telegraphy.

The Berlin Academy of Sciences has made an appropriation of 3,000 Marks to Dr. Blanco for a continuation of his geological investigations, and of 1,500 Marks to Professor Boveri for investigations on the fertilization and early development of the egg.

We regret to announce the death of the eminent magnetist, Professor Max Eschenhagen, at the age of 43 years. He has been in charge of the Royal Prussian Magnetic Observatory since its establishment in 1899, and he took a very active part in the planning of the magnetic work of the German Antarctic expedition and in arranging the international work to be carried out simultaneously over the entire globe during the period of the expeditions. His contributions to terrestrial magnetism are numerous, his skill exhibiting itself especially in the improvement of magnetic instruments and in the designing of new ones. His light, convenient, portable magnetographs will be extensively used in the international work.

The death is announced at the age of 59 years of Mr. A. H. Smee, author of valuable contributions to chemistry and physiology. He was the principal medical adviser of the Gresham Life Assurance Society, and his statistical reports on rates of mortality are standard authorities.

The archeological field work, conducted in central New Brunswick during the past summer by Mr. Samuel W. Kain, yielded good results, but owing to Mr. Kain's ill health the report will not be published for some time.

The Imperial Academy of Sciences of Vienna has received, according to *Nature*, intelligence of the botanical expedition in Brazil, from its chief, Professor R. von Waldheim, down to September 10, from São Paulo. The rivers Rio Branco, Rio Mambu and Rio Aguapihy, flowing through an almost unexplored country, had been navigated in canoes; and large consignments have already been sent to Vienna in the form of living plants and roots, herbarium specimens, preparations in spirit, woods, fruits and economic products.

Reuter's Agency reports from St. Petersburg that uneasiness is no longer felt regarding the fate of the scientific expedition under Lieutenant Kozloff, which was reported some time ago to have been massacred by a band of Tibetans, as news has been received stating that the expedition left Si-ning-fu, which is near Lake Kokonor, on September 12, for Fushar. The expedition was escorted by Chinese soldiers, and further news has been received from the Russian Consul at Chuguchak, who had been informed by local authorities that the party had passed through Jan-lan and Datum.

The Royal Geographical Society of Antwerp announces an exposition to be opened in that city in May next. The object is to popularize geographical sciences, to make those countries recently opened to commercial activity better known, and to contribute to the development of the mercantile marine and of maritime enter-

prises. There will be a section devoted to ancient and modern maps and globes, surveying instruments, etc., which will comprise also meteorological and ocean-sounding apparatus. The committee proposes to assemble important ethnographical collections, in view of the interest taken in them by the public in regard to trans-oceanic enterprises. The participation of the Kongo Free State will largely contribute to the success of this section. Besides the colonial section, there will be a department devoted to everything relating to the progress of navigation. Models of ships and of great maritime works, improvements in the art of navigation, and trophies of voyages of exploration will be exhibited. It is desired to give to the exhibition an international character.

THE subject for the Spendiaroff prize of the International Geological Congress for 1893 is a critical review of methods of classifying minerals. Two copies of the paper must be sent before the next congress to the secretary of the last congress, M. Charles Barrois, 62 Boulevard, Saint-Michel, Paris. The value of the prize is about $225.

THE November meeting of the Faculty Science Club of Wellesley College was addressed by Professor Cummings of the department of botany, to whom the lichens of the Harriman Alaskan Expedition were sent for identification. She showed on the map the region covered by this and former collecting parties, and stated that among the thousand specimens put into her hands three new species had been found and 76 not before known in Alaska.

The Botanical Gazette states that the herbarium of Theodor von Heldreich, professor of botany and director of the Botanic Gardens, Athens, is for sale. It contains approximately 20,000 species, and richly represents the floras of Greece, Asia Minor and Egypt. It contains also hundreds of types and authentic specimens of new species, described by Heldreich in the works of Bossier.

BY the will of the late Mrs. Charles E. Balch, of Manchester, N. H., the Manchester Institute of Arts and Sciences of that city is a beneficiary to the extent of $50,000, in securities and real estate to the value of about $30,000. The will provides that the bequest is to be applied to the purposes of the Fine Arts section of the Institute.

A COLLECTION of butterflies, containing over 5,000 specimens, has been given to the Art Gallery of the Plainfield, N. J., Public Library by Mr. Alexander Gilbert.

THE National Educational Association will hold its next annual meeting in Indianapolis, beginning on July 7.

THE twenty-second annual exhibition of the New York Microscopical Society will be held on the evening of December 6, at the rooms of the Society in the Mott Memorial Building, 64 Madison Avenue. The exhibition will be open to the public, but cards of admission will be necessary. These will be sent to those who apply by letter to Dr. George W. Kosmak, 23 East Ninety-third Street.

THE Imperial Leopold Caroline Academy of Sciences at Halle will celebrate the one hundred and fiftieth anniversary of its foundation on January 1, 1902.

AS the result of a meeting held at Frankfort, under the presidency of Professor Edinger and addressed by Professor Hagen, it was decided to establish in that city a branch of the German Anthropological Society.

IT has been previously announced in these columns that the *Botanische Centralblatt* has become the property of the Association Internationale des Botanistes. Arrangements for its transfer to the Association have been completed, and it will be published at Leyden beginning January 1, 1902, under the direction of an editor-in-chief appointed by the Association. Arrangements have been made for the appointment of a board of special editors in England, America and France, and reviews will henceforth be published in English, French and German. Beginning with the first of January, 1902, the *Centralblatt* will be sent gratis to all members of the Association. The annual fee for members is 25 shillings. The number of representatives on the general committee of the Association to which any country is entitled depends on the number of members living in that country. The names of previous subscribers to the *Centralblatt* are of course known to the editors in cases where the subscriptions were taken in the

subscribers' own names, but where copies were ordered through book sellers or other agents the subscribers' names or even the countries in which they reside are not known. In order, therefore, that the editors may be enabled to know the exact number of members residing in this country and thus ascertain the number of representatives on the committee to which we are proportionally entitled, all desiring to join the Association who have not already registered as members should send their names at once to the Secretary, Dr. J. P. Lotsy, care of E. J. Brill, Leyden, Holland. Any person may join the Association, and institutions, such as colleges, libraries, etc., are eligible to membership and can, by joining the Association, receive the *Centralblatt* on the same terms as private individuals. The subscription price of the *Centralblatt* to non-members of the Association is 28 shillings.

THE United States Coast and Geodetic Survey will have on January 1, 1902, four magnetic observatories cooperating in the international magnetic work to begin on that date and to continue during the period of antarctic exploration, viz: one at Cheltenham, Md., near Washington, D. C., another at Baldwin near Lawrence, Kansas, a third at Sitka, Alaska, and a fourth near Honolulu, Hawaiian Islands.

THE Göttingen Academy of Sciences has decided to establish and maintain at its own expense, during the period of the special international magnetic work, a magnetic observatory near Apia, in the Samoan Islands. The observatory will be equipped for observations in terrestrial magnetism, atmospheric electricity, meteorology and seismology. This observatory will be nearly magnetically south of the Honolulu observatory and about the same distance south of the magnetic equator as the latter is north of it. The two observatories will likewise use practically the same instruments and methods, so that interesting and valuable contributions may be expected from them. Mr. A. Nippoldt, of the Potsdam Observatory, will be in charge of the Samoan Observatory.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. F. A. SAMPSON, of Sedalia, Mo., has presented to the University of Missouri his library of Missouriana, a collection which is valued at $25,000, and Professor Litton, formerly of Washington University, St. Louis, who died recently, bequeathed to the University a valuable collection of scientific apparatus and books.

THE sum of $1,200 has been pledged with which to purchase books for an alcove in chemistry at Cornell College, Mount Vernon, Iowa.

It is stated in the New York *Evening Post* that it has been decided by the alumnæ of Wellesley College to use certain funds in hand for an oil portrait of Helen A. Shafer, professor of mathematics in the college from 1877 to 1888, and president from 1888 to 1894, and for the purchase of books, models and other permanent equipment for the department of pure mathematics; and, in addition, to establish a fund of $2,000 to be turned over to the trustees and invested by them as the Shafer Memorial Fund, the interest to be expended for the benefit of the above department.

THE trustees of Clark University, at Worcester, Mass., have voted to establish a collegiate department in accordance with the will of the late Jonas Clark. E. Harlow Russell, principal of the State Normal School at Worcester, has been selected for president of the department, which is to come into operation in October, 1902.

MR. REGINALD GORDON, instructor in physics in Columbia University, has resigned to enter a mercantile business. His place will be taken by H. C. Parker, now a tutor in physics, and Mr. Parker's tutorship will be filled by G. B. Pegram, now an assistant.

MR. H. O. JONES, Clare College, Cambridge, has been appointed Jacksonian demonstrator in chemistry in place of the late Mr. W. T. N. Spivey.

MR. H. S. DAVIS, graduate student in zoology at Harvard University, has been appointed instructor in vertebrate zoology at the Washington Agricultural Experiment Station, Pullman, Washington.

PROFESSOR PAUL KAUFMANN has resigned the chair of pathology in the University of Missouri.